

DRAFT

ENVIRONMENTAL IMPACT REPORT

***LAND USE PLANNING POLICY WITHIN
THE 100-YEAR FLOOD PLAIN IN THE
CITY AND COUNTY OF SACRAMENTO***



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September 18, 1989

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**LAND USE PLANNING POLICY
WITHIN THE 100-YEAR FLOOD PLAIN
IN THE CITY AND COUNTY OF SACRAMENTO**

Prepared By:

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Sacramento, CA


Prepared For:

City of Sacramento
Planning and Development Department

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1. INTRODUCTION

1. INTRODUCTION

Type of Document

This Environmental Impact Report (EIR) has been prepared in compliance with the California Environmental Quality Act (CEQA) and the environmental guidelines of the City of Sacramento. The report addresses issues that were determined to be potentially significant in the Notice of Preparation, prepared by the City of Sacramento and published on July 18, 1989. The Notice of Preparation is attached as Appendix B of this report. Responses to the Notice of Preparation which were received by the City during the 30-day comment period are included in Appendix C.

This document has been prepared in compliance with State and local EIR guidelines and has been compiled from a variety of sources including published and unpublished studies, applicable maps and readily available demographic and development projections from local and regional agencies. The information in this report is subject to review by the City, responsible agencies, and the public. The draft version of this report may be amended in the Final EIR to consider concerns raised during the public review process.

Project Under Review

The proposed project involves the adoption by ordinance of a land use planning policy for the 100-year flood plain. This policy has been developed in response to new information from the U.S. Army Corps of Engineers (USCOE) and the Federal Emergency Management Agency (FEMA) that indicates a need for increased flood protection control measures in order to provide 100-year flood protection for all areas newly identified in the 100-year flood plain within the Sacramento metropolitan area. This EIR is intended to enable the City of Sacramento, Sacramento County, interested agencies, and local citizens to evaluate the Proposed Land Use Policy's effect on the environment and to examine and institute methods of mitigating adverse environmental impacts.

The EIR focuses on the environmental effects of the increment of growth which would be allowed under the Proposed Land Use Policy. The EIR also evaluates the effects of the Proposed Land Use Policy in conjunction with existing levels of development in areas subject to flooding. A more detailed description of the components of the cumulative analysis is included in Section 5.1, Introduction to the Analysis.

EIR Process

This EIR will initially be published as a Draft EIR and will be subject to review and comment by the public as well as all responsible agencies and other interested jurisdictions, agencies and organizations during a period of 45 days, beginning September 18, 1989 and ending November 1, 1989. Two public hearings will be held to receive comments on this Draft EIR. One hearing will be held by the Sacramento Metropolitan Flood Protection Task Force on Thursday, October 26, 1989 at 1:30 PM. A second hearing will be held by the Sacramento City Planning Commission on Thursday, October 26, 1989 at 5:30 PM. After the public hearings, written responses will be prepared to all oral and written comments received on the Draft EIR. The responses to comments may specify changes to the Draft EIR. The responses to comments and any changes to the Draft EIR therein specified will be incorporated into the Draft EIR, and, as such, will become the Final EIR. The Final EIR will be presented to the Sacramento City Council for certification as to its adequacy under CEQA before the City Council acts on the policy.

2. EXECUTIVE SUMMARY

2. SUMMARY

Project Description

The "project" under evaluation in this EIR is a proposed Land Use Planning Policy for the 100-year flood plain. This policy was developed by the Sacramento Metropolitan Flood Task Force in response to the flood protection requirements of Special Legislation for the Sacramento area contained in the McKinney Homeless Assistance Act of 1988.

The Proposed Land Use Policy Within The 100-Year Flood Plain contains the following five elements:

▣ Change of Land Use

"The City and County reaffirm their commitment to Congress not to designate any increases in urbanization beyond lands already so designated in the City's General Plan or in the County's pending General Plan update during the period covered by the Special Legislation. It is, however, understood that annexations where no increases in urbanization are contemplated will be processed. The County's General Plan is being prepared with the full knowledge of the flooding issues identified by the USCOE and the strategies and programs being developed by the City/County Office of Flood Control Planning. Policies will be developed for inclusion in the General Plan which support these strategies and which will prohibit construction in any flood hazard area until flood solutions are in place. Approval of General Plan designations will not automatically result in the ability to secure building permits consistent with those designations. Property owners must file and secure approval of zoning classifications which are consistent with General Plan designations. In addition to this commitment, applications for zoning or pre-zoning changes within the flood plain and not consistent with existing City and County General Plans from agricultural to urban use will not be approved during the period covered by the Special Legislation approval by Congress in 1988."

The following four policy elements apply only to that portion of the 100-year flood plain designated as the Sacramento River Levee Failure Flood Potential Map, shown in Figure 2 on page 3-3. These elements will remain in effect until construction contracts for levee stabilization are awarded and the City Council and Board of Supervisors determine that the flood risk is acceptable.

▣ Discretionary Entitlements For Residential Projects That Have Been Filed After April 1, 1989

"Tentative and final maps and other discretionary entitlements will continue to be processed. However, no building permits shall be approved by the City or County unless it can be shown that the project can be built in accordance with the USCOE

January, 1989 working maps, and any other applicable City and County regulations. A note to this effect shall be placed on the final map. The City and County shall take the necessary steps to remove this note when appropriate.

□ Discretionary Entitlements For Residential Projects That have Been Filed By April 1, 1989

"Existing residential projects which have tentative maps, final maps, special permits or plan reviews which have been filed prior to April 1, 1989 will be allowed to proceed subject to the owners' signing all legal conditions and waivers as developed by the City Attorney's or County Counsel's Office prior to recordation of final map or issuance of building permit whichever occurs first."

□ Development Agreements

"Property owners of properties under development agreements ('developers') have suggested that the agreements prohibit the City from delaying development of those properties until flood control measures are in place or contracted for. The City believes that the development agreement and federal authority may authorize the City to delay development until flood protection measures are in place or contracted for. Both the City and these developers agree that the flooding risk pertains to the construction of buildings, not the approval of development entitlements such as tentative subdivision maps, final maps or special permits. Hence, the City will review on a case-by-case basis requests for entitlements for property under development agreements. The City may require that the property be built in accordance with the USCOE January 1989 working maps, and other applicable City regulations."

□ Non-Residential Buildings

"Non-residential buildings shall be designed by an architect or civil engineer so as to minimize the extent of structural damage sustained in the event of a 100-year flood. Design standards to be used for the City will be prepared by the City Building Inspections Division. Design standards for the County will be prepared by the County Public Works Department. Projects accepted for plan check prior to April 1, 1989 will be exempt from these requirements."

Project Location

The Proposed Land Use Policy would apply to all development in areas of the City of Sacramento and Sacramento County located in the 100-year flood plain identified on the preliminary Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) or the Special Map (Sacramento River Failure Flood Potential Map) attached to the policy.

Project Objectives

The City and County of Sacramento have several objectives in proposing this policy. These objectives include the following:

- To comply with the intent and spirit of the Special Legislation.
- To avoid undue exposure to the risks of floods.
- To minimize potential disruption in the Sacramento region and to avoid the precipitous break-up of the political, institutional, and economic relationships sustaining the high level, comprehensive flood protection effort.

Project Approvals

Approval of Land Use Planning Policy

It is expected that the City Council and the Board of Supervisors will adopt the Proposed Land Use Policy Within the 100-Year Flood Plain by ordinance. It is further expected that those ordinances will be rescinded at some time in the future, at the discretion of each representative body.

Certification of Environmental Impact Report (EIR)

This Draft EIR will be circulated for public comment from September 18, 1989, through November 1, 1989. Written comments from the public and other interested agencies may be submitted at any time during the comment period. There will be a public hearing before the City Council during the comment period. The EIR authors will respond in writing to all comments received during the comment period. The Comments and Responses document and the Draft EIR together will constitute the Final EIR, which will be considered by the City Council for certification as to its objectivity, accuracy, and completeness.

Scope of EIR

This EIR addresses the following issues identified in the Notice of Preparation issued by the City of Sacramento:

- Land Use
- Plan and Policy Consistency
- Public Health and Safety
- Cumulative Impacts
- Growth Inducements

Historical Background

The 100-Year Flood

A 100-year flood is a flood of such magnitude that there is statistically a 1 percent chance of its occurrence in any given year. Protection from a 100-year flood requires that the rivers and levee systems within which the 100-year flood flows must be stable

enough and of sufficient size to contain these flows while maintaining a minimum level of "freeboard," the distance between the water level a levee is designed to accommodate and the top of the levee. FEMA regulations require a minimum of three feet of freeboard.

Existing Flood Control System

Flood control facilities along the Sacramento and American River drainages consist of a comprehensive system of dams, levees, overflow weirs (diversion structures in the river intended to ensure a maximum flow in the river), drainage pumping plants, and flood control bypass channels (see Figures 3 and 5 in Section 4.1). Such facilities harness flood flows by regulating the amount of water passing through a particular reach of the river. The American River flood control system was planned with a design discharge out of Folsom Dam of 115,000 cubic feet per second (cfs). The Sacramento River flood control system was designed to hold the maximum flow of about 110,000 cfs downstream of the American River, and a maximum flow from Fremont Weir south to the American River of 107,000 cfs. The American River levees are designed to have a minimum of five feet of freeboard, while the Sacramento River levees maintain a minimum of three feet of freeboard.

Sacramento River Flood Control System

Primary elements of the Sacramento River Flood Control System include the following:

- ✧ Fremont Weir
- ✧ Sacramento Weir
- ✧ Yolo Bypass Channel
- ✧ Sacramento Bypass Channel
- ✧ Levees along the Sacramento River, Lower American River, Natomas East Main Drainage channel (NEMDC), Arcade Creek, Natomas Cross Channel and the Yolo Bypass channels
- ✧ Upstream storage facilities

The design flow of the Sacramento River System from Fremont Weir to the Sacramento Weir is 107,000 cfs and downstream of the American River is 110,000 cfs. The levees along both sides of the Sacramento River were designed to carry these flows with at least three feet of freeboard. Excess flood waters are discharged through the Fremont and Sacramento Weirs and into the Sacramento and/or Yolo Bypass Channels.

American River Flood Control System

The American River Flood Control System includes the following primary elements:

- ✧ Sacramento Weir
- ✧ Folsom Dam (a 340-foot high concrete-earthfill dam on the main stem of the American River)
- ✧ Nimbus Dam, a Folsom afterbay
- ✧ One auxiliary dam at Mormon Island
- ✧ Eight earthfill dikes
- ✧ About six miles of levees on the north bank of the American River (from Howe Avenue to Arden Way)
- ✧ About 11 miles of levees on the south bank of the American River

The American River System was constructed with a design flow from Folsom Dam of 115,000 cfs. The levee system downstream of Folsom was designated to accommodate 115,000 cfs with five feet of freeboard.

The Flood of 1986

Prior to 1986, it was believed that urban Sacramento's 110-mile levee system was sufficient to withstand at least a 100-year flood. The February 1986 storm produced record flows in both the Sacramento and American River drainages. At one point in the storm, the Sacramento River above the Natomas area carried about 134,000 cfs, 19,000 cfs (or 16.5 percent) higher than its design capacity. The levees contained the flow from the storm but, in many cases, there was encroachment into the design freeboard and erosion of the levee embankment.

During the same storm, the Sacramento River also experienced the highest stage ever recorded. At the "I" Street Bridge in downtown Sacramento, the system had been designed to have a minimum of three feet of freeboard and handle 110,000 cfs. The flow peaked at 117,000 cfs. At some locations along the river, the peak left between one to two feet of freeboard remaining. The Sacramento River levee along the Garden Highway, north of Metro Airport, began to slip. During the storm, 10 separate slips occurred in this area and were repaired on the land side of the levee.

An outgrowth of the 1986 floods was a re-evaluation by the U.S. Army Corps of Engineers (USCOE) of the magnitude of the 100-year flood event, the condition of existing levees and the level of protection provided by the existing flood control system. The USCOE found that the 100-year flood event was much larger than previously thought and that the existing American River flood control system provides an average flood protection of only 63 years, with as little as 40 years in some parts of Natomas as a result of stability problems with the Sacramento River

levees (Garden Highway). Accordingly, the USCOE has determined that a portion of the City and western county lie within the 100-year flood plain.

Regulatory Response

In response to the increased concern about flood protection in the Sacramento area, six separate studies were initiated. Briefly described, the six studies are:

✧ Sacramento River Flood Control System Evaluation

The USCOE assessed specified sections of the Sacramento River Flood Control Project to determine if they can perform as originally designed. The first phase of this study determined that 32 miles of levees protecting urban Sacramento were unstable and needed remedial work if they were to perform as originally designed (see Figure 8 on page 50). Additional phases of this study will evaluate other portions of the Sacramento River system from Chico Landing in the north to Collinsville in the south.

✧ FEMA Flood Plain Mapping

The USCOE, under contract with FEMA, mapped the 100-year flood plain for Sacramento based on new rainfall runoff and their most recent evaluation of the levee system, and distributed copies of the maps to the City and County in November 1988. In January 1989, the maps were given to FEMA. That agency issued preliminary maps in May 1989 and anticipates issuing final maps before the end of 1989 (see Figure 1 on page 26).

✧ Folsom Reoperation

The USCOE, through a separate study, is evaluating the potential for acquiring additional upstream storage on the American River through the reoperation of Folsom Dam. Reoperation involves the allocation of greater storage capacity in Folsom Lake for storm flows. The USCOE is looking at alternatives to increase flood storage and evaluating the related effects on flood control, supply and use of water, and the environment. A draft report and Environmental Impact Statement (EIS) should be available in October 1989.

✧ Dry Creek (Roseville)

The USCOE is evaluating flooding along the Dry Creek drainage through the City of Roseville.

✧ Sacramento Metropolitan Area

The Sacramento Metropolitan Study Reconnaissance Report by the USCOE was first published in February, 1989 and was revised in April, 1989. The study area evaluated reaches from Fremont Weir (near the

confluence of the Sacramento and the Feather rivers) to Freeport. The purpose of the study is to determine the extent of weir control, levee freeboard, and stability problems within this area of the flood control system and to recommend feasible alternative solutions.

✧ American River Watershed

The American River Watershed Feasibility Study by the USCOE began in July 1988, and is evaluating alternatives for providing higher levels of protection on the American River flood control system including the whole Natomas area. The study, to date, has concluded the existing facilities only provide 63-year level of flood protection and is investigating alternatives to provide at least a 200-year level of protection.

Legislative Response

The Special Legislation established the legal framework within which Sacramento's governmental authorities are responding to the new flood maps prepared by the USCOE for the greater Sacramento area.

In order to participate in the National Flood Insurance Program (NFIP) and thereby mitigate potential losses due to flooding, the City and County must satisfy certain statutorily mandated flood plain management criteria. These criteria, along with the actuarial (risk-based) insurance rates applicable under the NFIP, are established on the basis of flood map elevation determinations made by the Director of FEMA based on data provided by the USCOE. The Special Legislation prohibits FEMA from using the USCOE's new data to impose new flood insurance rates and design and use restrictions in Sacramento, and permits existing elevations and rates to be continued for up to four years as necessary in order to give Sacramento an opportunity to mount an effective flood control effort. Under the Special Legislation, the City and County may permit such new development in the flood plain at existing elevations and insurance rates as may be required to preserve the institutional and economic relationships necessary to sustain an effective flood control protection effort. In this regard, the City and County have assured Congress they will avoid undue exposure to the dangers of floods and will comply to the maximum extent practicable with FEMA's updated base flood elevations.

In adopting the November 1988 Special Legislation, Congress has recognized that changed flood water surface elevation requirements attributable to a change in flood water surface elevation determinations by FEMA could cause severe disruption in the Sacramento region and could undermine the community's ability to carry out an effective flood protection effort. To avoid this consequence, the Special Legislation prohibits FEMA from altering established base flood elevations and determining any new elevations in the Sacramento area. The Special Legislation will expire in October 1992. This prohibition effectively precludes FEMA from charging actuarial flood insurance rates within the Sacramento area. In response to the Special Legislation, FEMA has designated the areas identified in the May 1989 Preliminary FIRM as a "Special Use" A-99. "This zone designation is normally reserved for flood-prone areas which meet the 'adequate progress' guidelines specified in Section

1307(e) of the National Flood Insurance Act. However, its use will allow administration of the NFIP in the Sacramento area in accordance with the expressed desires of the Congress." (FEMA, 1989) Accordingly, FEMA has agreed to continue to make flood insurance available at rates normally utilized outside areas of special flood hazard.

Sacramento Metropolitan Flood Protection Task Force

The Sacramento Metropolitan Flood Protection Task Force ("Task Force") was established in December 1988 with the task of overseeing Sacramento's local efforts to provide additional flood protection to the greater Sacramento area. After nearly two months of discussions with interested parties, the Task Force has recommended a set of policies to initiate Sacramento's flood planning effort. The "Land Use Planning Policy Within 100 Year Flood Plain," presented to the Sacramento City Council on June 7, 1989 (see Appendix A), embodies the land use element of the City's initial effort to ensure that development which occurs within the 100-year flood plain is consistent with the intent of the Special Legislation.

Other Elements of the Flood Protection Effort

The Proposed Land Use Policy is only one part of a comprehensive effort to respond to existing flood protection conditions and to improve the overall level of flood protection. There are other elements of the overall flood protection effort which are not evaluated in this document. These other elements are discussed below. Each of these other elements will be evaluated, if necessary, by the appropriate jurisdiction or agency, under the appropriate CEQA or NEPA processes.

Notification Requirements

The Task Force has recommended and the City and County have adopted an ordinance to establish procedures for notification of new home purchasers and others of the risk of flooding in areas of the City lying within the 100-year flood plain. The policy is also designed to ensure that those persons who decide to build, purchase, or otherwise obtain an interest in new construction in the flood plain, expressly assume the risk of flood-related property damage, thereby minimizing public exposure to losses due to flooding. The following summarizes the elements of the notification policy:

☐ Notice

Sellers of any new structures permitted to be built in the flood plain, and any agents or brokers representing such sellers, are required to give notice of the flood danger to prospective purchasers as soon as practicable before transfer of title. Where such transfers are processed through escrow, the primary escrow agent is required to verify that the notice has been delivered. This procedure applies to the initial sales of new structures and to any resales of these structures.

☒ Assumption of Risk

Prior to issuance of a building permit for any new construction or substantial improvement (\$50,000 or more) of an existing structure in the flood plain, the owners of the affected property must sign an agreement with the City acknowledging and assuming the risk of flooding, waiving any flood-related property damage claims against the City/County and indemnifying the City/County against any such claims. The agreement further requires that the owner give notice of the flood danger to any person who subsequently acquires an ownership or possessory interest in the property and obtain from any such person a waiver of flood-related property damage claims on behalf of the City/County. Compliance with this third-party notice and waiver provision entitles the owner to be released from any obligation to indemnify the City/County.

The City and County both determined that these notification policies did not constitute a project under CEQA and, therefore, no environmental review of these policies is required.

Physical Flood Protection Improvements

The land use and notification policies are only one part of Sacramento's comprehensive flood protection effort. In the long run, the City and County anticipate that physical improvements in the flood control system will create enough flood protection in all parts of Sacramento to render the land use and notification policies unnecessary. There are three essential elements of the physical flood control effort: levee stabilization (assumed completion date of 1992), some combination of levee improvement and additional upstream storage (assumed completion date of 1997).

Levee Stabilization

The first element of the Sacramento Flood Control effort is stabilization of 32 miles of levees along the Sacramento River that are in need of remedial work to correct latent construction defects. When completed, this work will allow the levees to perform as originally designed. The estimated cost of repairing these levees is \$38 million. The effect of this stabilization project will be to provide the Natomas area with an approximate 50-year level of flood protection. Flood protection in other areas will be approximately 63 years due to flooding from the American River. The USCOE is currently awaiting approval to begin engineering and design work to correct the levee deficiencies. Prior to start of this project, environmental evaluation under the provisions of the National Environmental Protection Act (NEPA) will be undertaken. It is anticipated that this project will be completed by 1992.

Additional Upstream Storage and Levee Improvements

The second element of the Sacramento Flood control effort is additional upstream storage.

Additional upstream storage could be obtained on a temporary basis through the reoperation of Folsom Dam. This project would involve reserving greater storage capacity in Folsom Lake during the November to April wet season. Provision of an additional 190,000 acre-feet of storage (over existing storage levels) in Folsom Lake would bring the total storage capacity up to approximately 600,000 acre-feet. This increased capacity would provide 100-year protection for the entire Sacramento metropolitan area with the exception of Natomas and areas located in the 100-year flood plain identified on the February, 1988 Effective FIRM.

Another way to provide additional upstream storage is to use existing upstream reservoir space for flood control.

Existing reservoirs upstream from Folsom Dam have a cumulative storage capacity of about 820,000 acre-feet (see Figure 4 on page 4.1-4). According to the USCOE American River Watershed Investigation Reconnaissance Report, "All of these reservoirs are used for water supply and/or hydroelectric power generation. None have designed flood control space. Since the reservoirs are at relatively high elevations, where much of the precipitation occurs as snow, they have minimal effect on floodflow reduction."

According to the USCOE in the American River Watershed Investigation Reconnaissance Report, there are conceptually two ways to obtain additional flood protection from these upstream reservoirs. One is to purchase flood control space from existing upstream reservoir capacity. The second would be to modify flood control operation of Folsom Dam in order to take advantage of any incidental available space. The USCOE, after studying the first alternative, determined that the annual cost of purchasing upstream reservoir storage space would exceed the flood control benefits by about two to one and was, therefore, not recommended for further consideration.

Evaluation of the second alternative showed that in many years a slightly increased level of flood control could be achieved with the incidental available spaces indicated in existing upstream reservoirs. However, full storage space in Folsom Dam would be required in some years when upstream storage was unavailable. The USCOE determined that giving credit for space in upstream reservoirs is believed to have potential when considered in combination with other measures for helping increase flood protection.

According to the USCOE American River Watershed Investigation Reconnaissance Report, additional flood storage can also be achieved by construction of either a single-purpose dam and reservoir or providing space in a new multipurpose facility upstream from Folsom Dam. To achieve 100-year protection, given the existing storage space of 400,000 acre-feet in Folsom, an additional 190,000 acre-feet of upstream storage would need to be provided.

Levee Improvements

The third element of the Sacramento Flood Control effort involves improvement of certain sections of the levee system protecting Sacramento. This will entail raising the height of these sections, in an effort to provide additional flood protection. It is anticipated that levee improvement along portions of Sacramento River, American River, Natomas East Main Drainage Canal (NEMDC), Pleasant Grove Creek Canal, Dry Creek, Arcade Creek, and Morrison Creek, in combination with additional upstream storage and levee stabilization will provide the greater Sacramento Area with 100-year protection.

According to the USCOE American River Watershed Investigation Reconnaissance Report, to decrease the likelihood of failure of the NEMDC west levee system due to 100-year flooding, about three miles of this system must be raised an average of three feet immediately downstream from Dry Creek, seven miles of the system levee from Elkhorn Boulevard to Sankey Road must be raised about one foot and all bridges over the canal except the Silver Eagle and I-80 bridges must be raised.

During high flows, the above modifications would induce flooding in the Dry and Arcade Creek areas. To mitigate this impact the USCOE would require the following:

- ✧ Raise the east levee of the NEMDC from the mouth at the American River to Dry Creek.
- ✧ Construct about four miles of new levee approximately 15 feet high along the east bank of the NEMDC from near Elverta Road to the confluence of Dry Creek and continuing upstream along the north side of Dry Creek to near Marysville Boulevard.
- ✧ Extend the existing south levee along Dry Creek to the Magpie Diversion Canal.
- ✧ Excavate and widen about three miles of the channel in Dry Creek from near Marysville Boulevard up the south side of Cherry Island.
- ✧ Raise the north levee along Arcade Creek from the NEMDC to Marysville Boulevard two feet.
- ✧ Raise 0.3 miles of south levee along Arcade Creek upstream from Marysville Boulevard.
- ✧ Construct 0.4 miles of new levees on both sides of Arcade Creek upstream from Marysville Boulevard to a height of about three feet.
- ✧ Raise or replace the bridges over Dry Creek at Elkhorn Boulevard, Rio Linda Boulevard, and Dry Creek Road.
- ✧ Raise or replace the bridges over Arcade Creek at Norwood Avenue and Marysville Boulevard. (The bridge at Rio Linda Boulevard is being replaced by the City of Sacramento.)

If levees were raised along the Natomas Cross Canal and Pleasant Grove Creek Canal, there would be an increase in potential flooding of the area northeast of the Pleasant Grove Canal. To mitigate the impacts associated with this increase, the USCOE recommended raising levees and bridges along the canals.

To upgrade the levees along the Sacramento and American Rivers adjacent to Natomas to accommodate 100-year flows would include the following:

- ▣ Raise the east levee of the Sacramento River one foot from the Natomas Cross Canal downstream for about five miles.
- ▣ Raise the north levee of the American River from the NEMDC downstream for about 1.5 miles one to two feet.
- ▣ Place stone protection along the north levee of the American River from the NEMDC to the Sacramento River.

Alternatives

As required by CEQA, this EIR evaluates a range of alternatives to the proposed project. The three alternatives analyzed were as follows:

- Alternative 1: No Project (required by CEQA)
- Alternative 2: Application of Existing Flood Plain Management Regulation Based on the USCOE January 1989 Working Maps
- Alternative 3: Application of the Proposed Land Use Policy to Non-Residential Structures Only

These alternatives and the comparative impacts of the alternatives are described in detail in Chapter 6. Table 19 compares the impacts of the alternatives on growth and on loss of life and property damage due to flooding.

The impacts of the Proposed Land Use Plan and of the No Project Alternative would be the same. Alternatives 2 and 3 would result in the least growth. Alternative 2, which would in effect result in a moratorium on growth in the areas shown to be in the 100-year flood plain on the USCOE Working Maps as long as 100-year flood protection is not available to those areas, would result in the least loss of life and property.

Impacts of the Proposed Project and Mitigation Measures

The following table (Table 1) summarizes project impacts and mitigation measures. The impacts and mitigation measures are more fully described in Chapter 5 of this EIR.

TABLE 1
IMPACTS AND MITIGATIONS SUMMARY

| Impact | Significance of Impact | Mitigation | Type of Mitigation Measure | Implementing Party |
|--|------------------------|---|----------------------------|--------------------|
| <u>SECTION 5.2 CONSISTENCY WITH PLANS, POLICIES, AND PROGRAMS</u> | | | | |
| City of Sacramento General Plan: The proposed Land Use Policy is not consistent with City General Plan policies related to flooding. | S/A | 1. Amend the Land Use Policy to add measures to reduce the risk of flood damage for all structures to be located in areas subject to the 100-year flood. Measures to reduce the risk of flood damage could include requirements to raise the elevation of the building pad or of the first floor of the structure one foot above the level of the 100-year flood. | REQ/BELOW | CITY |
| | | 2. Amend the City General Plan to define "areas subject to unreasonable risk of flooding" in Policy 1 to exclude areas designated A99 Flood Hazard zone on the FIRM for the area. This measure would reduce the inconsistency with the City General Plan by modifying the General Plan. | REQ/BELOW | CITY |
| City of Sacramento Flood Control Regulations: The Land Use Policy will be consistent with the existing City Flood Hazard regulations. | LTS | 3. NONE | NONE | N/A |
| County of Sacramento General Plan: The proposed Land Use Policy is not consistent with County General Plan policies related to flooding. | S/A | 4. Amend the Land Use Policy to add measures to reduce the risk of flooding for all structures to be located in areas subject to the 100-year flood. | REQ/BELOW | COUNTY |

N/A - Not Applicable
LTS - Less Than Significant
S/A - Significant Avoidable
S/U - Significant Unavoidable

None - No Impacts
REC/MAG - Recommended to Reduce Magnitude of Impact
REDUCE/MAG - Would Reduce Magnitude of Impact, But Would Not Make Less Than Significant
REQ/BELOW - Required to Reduce Impact Below a Level of Significance

Same as PP - Same as Proposed Project

TABLE 1
IMPACTS AND MITIGATIONS SUMMARY

| Impact | Significance of Impact | Mitigation | Type of Mitigation Measure | Implementing Party |
|---|------------------------|---|----------------------------|--------------------|
| | | 5. Amend the County General Plan to define "unprotected flood land" to exclude areas designated A99 Flood Hazard zone on the FIRM for the area. This measure would reduce the inconsistency with the County General Plan by modifying the General Plan. | REQ/BELOW | COUNTY |
| County of Sacramento Flood Control Regulations: The Land Use Policy will be consistent with the existing County Flood Hazard regulations. | LTS | 6. NONE | NONE | N/A |
| Department of Fish and Game Streambed Alteration Agreement: A Streambed Alteration Agreement will be necessary for some development that takes place within the 100-year flood plain. | LTS | 7. NONE | NONE | N/A |
| National Flood Insurance Program: The Land Use Policy will be consistent with Federal plans and regulations related to flooding. | LTS | 8. NONE | NONE | N/A |

SECTION 5.3 LAND USE

| | | | | |
|---|------------|---------|------|-----|
| The Proposed Land Use Policy would eliminate the possibility of any annexations to the City, or General Plan amendments (City or County) that would result in an increase in urbanization or the conversion of agricultural land. | BENEFICIAL | 9. NONE | NONE | N/A |
|---|------------|---------|------|-----|

N/A - Not Applicable
LTS - Less Than Significant
S/A - Significant Avoidable
S/U - Significant Unavoidable

None - No Impacts
REC/MAG - Recommended to Reduce Magnitude of Impact
REDUCE/MAG - Would Reduce Magnitude of Impact, But Would Not Make Less Than Significant
REQ/BELOW - Required to Reduce Impact Below a Level of Significance

Same as PP - Same as Proposed Project

TABLE 1
IMPACTS AND MITIGATIONS SUMMARY

| Impact | Significance of Impact | Mitigation | Type of Mitigation Measure | Implementing Party |
|--|------------------------|--|----------------------------|---------------------|
| The Proposed Land Use Policy would not measurably decrease the amount of development and growth to occur in the 100-year flood plain during the 1988 to 1997 time period. | LTS | 10. NONE | NONE | N/A |
| SECTION 5.4 FLOOD HAZARDS | | | | |
| <u>Property Damage</u> | | | | |
| Existing Level of Flood Protection | | | | |
| Natomas: The 100-year flood could result in approximately 3.1 billion dollars in property damage to new development in the period from 1989 to 1992 as a result of the project (see Table 5). There is a 1 percent chance of this occurring in any given year. It can be estimated that there is a 3.9 percent chance of the 100-year flood event occurring during this four-year period. | S/U | 11. Prohibit development in those areas shown to be subject to the 100-year flood on USCOE working maps, unless that development can comply with FEMA requirements for development in an AE flood hazard zone. FEMA requirements include raising the first floor for residential structures to at or above the level of the 100-year flood. Section 4.2 sets forth specific requirements of the National Flood Insurance Program for the AE flood hazard zone. | REQ/BELOW | CITY |
| Remaining Flood Plain Area: The 100-year flood could result in approximately 500 million dollars in property damage to new development in the Natomas area in the period from 1989 to 1992 as a result of the project. | | 12. Require flood protection measures for each project as a condition of development. Some developments could be protected by levees | REDUCE/MAG | CITY/ DEVELOPERS |
| <div> <div> N/A - Not Applicable LTS - Less Than Significant S/A - Significant Avoidable S/U - Significant Unavoidable </div> <div> None - No Impacts REC/MAG - Recommended to Reduce Magnitude of Impact REDUCE/MAG - Would Reduce Magnitude of Impact, But Would Not Make Less Than Significant REQ/BELOW - Required to Reduce Impact Below a Level of Significance </div> <div> Same as PP - Same as Proposed Project </div> </div> | | | | |

TABLE 1
IMPACTS AND MITIGATIONS SUMMARY

| Impact | Significance of Impact | Mitigation | Type of Mitigation Measure | Implementing Party |
|--|------------------------|---|----------------------------|--------------------|
| <p>There is a 1 percent chance of this occurring in any given year. It can be estimated that there is a 3.9 percent chance of the 100-year flood event occurring during this four-year period.</p> <p>Levee Stabilization</p> <p>Remaining Flood Plain Area: The 100-year flood could result in approximately 2.8 billion dollars in property damage to new development in the period from 1992 to 1997 as a result of the project (see Table 5). There is a 1 percent chance of this occurring in any given year. It can be estimated that there is a 4.9 percent chance of the 100-year event occurring during this five-year period.</p> <p>Natomas: The 100-year flood could result in approximately 304 million dollars in property damage to new development in the Natomas area in the period from 1992 to 1997 as a result of the project (see Table 5). There is a 1 percent chance of this occurring in any given year. It of the 100-year event occurring during this five-year period.</p> | | <p>around the development itself or other flood protection measures constructed as a part of the project.</p> <p>13. Prohibit development in those areas shown to be subject to flood depths of greater than 3 feet in the event of the 100-year flood, as shown on USCOE working maps, unless that development can comply with FEMA requirements for development in an AE flood hazard zone. Depth damage curves used for impact analysis show that damage is 50 percent and greater when flood depths reach levels over 3 feet.</p> | REQ/BELOW | CITY |

N/A - Not Applicable
LTS - Less Than Significant
S/A - Significant Avoidable
S/U - Significant Unavoidable

None - No Impacts
REC/MAG - Recommended to Reduce Magnitude of Impact
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TABLE 1
IMPACTS AND MITIGATIONS SUMMARY

| Impact | Significance of Impact | Mitigation | Type of Mitigation Measure | Implementing Party |
|--|------------------------|--|----------------------------|---------------------|
| Additional Upstream Storage and Levee Improvement | | | | |
| Natomas: The 100-year flood could result in approximately 690 million dollars in property damage to new development as a result of the project, each year after 1997 that flood protection measures providing 100-year flood protection are not implemented There is a 1 percent chance of this occurring in any given year. | S/U | 14. Until 100-year flood protection is provided, prohibit development in those areas shown to be subject to the 100-year flood on USCOE working maps, unless that development can comply with FEMA requirements for development in an AE flood hazard zone. | REQ/BELOW | CITY |
| Remaining Flood Plain Area: The 100-year flood could result in approximately 1.1 billion dollars in property damage to new development as a result of the project each year after 1997 that flood protection measures providing 100-year protection are not implemented. There is a 1 percent chance of this occurring in any given year. | | 15. Until 100-year flood protection is provided, require flood protection measures for each project as a condition of development. Some developments could be protected by levees around the development itself or other flood protection measures constructed as a part of the project. Provision of flood control measures on a project-by-project basis over the long term could interfere with the comprehensive flood plain control effort. | REDUCE/MAG | CITY/ DEVELOPERS |
| | | 16. Until 100-year flood protection is provided, prohibit development in those areas shown to be subject to flood depths of greater than three feet in the event of the 100-year flood, as shown on USCOE working maps, unless that development can comply with FEMA requirements for development in an AE flood hazard zone. Depth damage | REDUCE/MAG | CITY/ |

N/A - Not Applicable
LTS - Less Than Significant
S/A - Significant Avoidable
S/U - Significant Unavoidable

None - No Impacts
REC/MAG - Recommended to Reduce Magnitude of Impact
REDUCE/MAG - Would Reduce Magnitude of Impact, But Would Not Make Less Than Significant
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IMPACTS AND MITIGATIONS SUMMARY

| Impact | Significance of Impact | Mitigation | Type of Mitigation Measure | Implementing Party |
|--|------------------------|--|----------------------------|--------------------|
| <p>curves used for impact analysis show that damage is 50 percent and greater when flood depths reach levels over three feet.</p> <p><u>Potential Loss of Life</u></p> <p>Existing Level of Flood Protection</p> <p>Natomas: The 100-year flood could result in approximately 17 fatalities from the population projected in the period from 1989 to 1992 as a result of the project. There is a 1 percent chance of this occurring in any given year. It can be estimated that there is a 3.9 percent chance of the 100-year flood event occurring during this four-year period.</p> <p>The Pocket Area: The 100-year flood could result in approximately 10 fatalities from the population projected in the period from 1989 to 1992 as a result of the project. There is a 1 percent chance of this occurring in a given year. It can be estimated that there is a 3.9 percent chance of the 100-year flood event occurring during this four-year period.</p> | | | | |
| | | 17. Prohibit development in those areas shown to be subject to the 100-year flood on USCOE May 1989 working maps, unless that development can comply with FEMA requirements for development in an AE flood hazard zone. FEMA requirements include raising the building of residential structures to one foot above the level of the 100-year flood plain. Section sets forth specific requirements of the National Flood Insurance Program for the AE flood hazard zone. | REQ/BELOW | CITY |
| | | 18. Prohibit development in those areas where flood inundation time is less than two hours. According to the USCOE American River Watershed Investigation Reconnaissance Report, two to six hours is considered a relatively long warning time providing for adequate evacuation. | REDUCE/MAG | CITY |
| | | 19. Implement upstream storage and levee | REDUCE/MAG | SACRAMENTO |

N/A - Not Applicable
LTS - Less Than Significant
S/A - Significant Avoidable
S/U - Significant Unavoidable

None - No Impacts
REC/MAG - Recommended to Reduce Magnitude of Impact
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Same as PP - Same as Proposed Project

TABLE 1
IMPACTS AND MITIGATIONS SUMMARY

| Impact | Significance of Impact | Mitigation | Type of Mitigation Measure | Implementing Party |
|--|------------------------|---|----------------------------|--|
| <p>Remaining Flood Plain Area: The 100-year flood could result in approximately two fatalities from the population projected in the period from 1989 to 1992 as a result of the project. There is a 1 percent chance of this occurring in any given year. It can be estimated that there is a 3.9 percent chance of the 100-year flood event occurring during this four-year period.</p> | | improvement projects prior to 1997. For each year that 100-year flood protection is achieved the number of fatalities could be reduced. The temporary reoperation of Folsom Dam could be potentially implemented prior to 1997 according to the USCOE. | | FLOOD CONTROL PLANNING OFFICE |
| | | 20. Implement flood fighting procedures at first warning of the onset of a flood event. Such procedures include emergency levee repair (i.e., sand bagging, placement of drain pipes and fill material), and the operation of strategically located flood gates. Flood fighting can be a measure to potentially slow the levee failure process and help hold back flood waters. | REDUCE/MAG | CITY/COUNTY |
| | | 21. Implement public flood awareness programs to explain the risk associated with a flood event. Public flood awareness programs implemented by such agencies as the Office of Emergency Services, and City and County emergency planning departments may help to educate a certain percentage of the population within the study area as to risks associated with flooding, and the importance of speedy evacuation. | REDUCE/MAG | CITY/COUNTY OFFICE OF EMERGENCY SERVICES |

N/A - Not Applicable
LTS - Less Than Significant
S/A - Significant Avoidable
S/U - Significant Unavoidable

None - No Impacts
REC/MAG - Recommended to Reduce Magnitude of Impact
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REQ/BELOW - Required to Reduce Impact Below a Level of Significance

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IMPACTS AND MITIGATIONS SUMMARY

| Impact | Significance of Impact | Mitigation | Type of Mitigation Measure | Implementing Party |
|---|------------------------|---|----------------------------|--------------------|
| | | 22. Expedient implementation of the City of Sacramento's Multi-Hazard Emergency Plan and Sacramento County's Multi-Functional Plan. The multi-hazard plans contain general information on type of flood event (i.e., river flood-slow rise (overtopping) or flash (levee break)); how the river stages are determined; public works flood hazard maps for specified areas; and areas of probable minimum and maximum flooding. The plans contain management guidelines on how the various City/County agencies interact during a flood event. | REDUCE/MAG | CITY/COUNTY |
| | | 23. Implementation of the four-stage river warning system. The City of Sacramento has implemented a four-stage river warning system as a flood advisory system (see Appendix F). | REDUCE/MAG | CITY |
| Levee Stabilization | | | | |
| Natomas: The 100-year flood could result in approximately .37 fatalities to population projected in the period from 1992 to 1997 as a result of the project. There is a 1 percent chance of this occurring in any given year. It can be estimated that there is a 4.9 percent chance of the | S/U | 24. Please refer to Mitigation Measures 17 to 23 for mitigation measures for these impacts. | | |
| N/A - Not Applicable LTS - Less Than Significant S/A - Significant Avoidable S/U - Significant Unavoidable | | None - No Impacts REC/MAG - Recommended to Reduce Magnitude of Impact REDUCE/MAG - Would Reduce Magnitude of Impact, But Would Not Make Less Than Significant REQ/BELOW - Required to Reduce Impact Below a Level of Significance | | |
| | | Same as PP - Same as Proposed Project | | |

TABLE 1
IMPACTS AND MITIGATIONS SUMMARY

| Impact | Significance of Impact | Mitigation | Type of Mitigation Measure | Implementing Party |
|--|------------------------|---|----------------------------|--------------------|
| 100-year event occurring during this five-year period. This is a significant impact. | | | | |
| The Pocket Area: The 100-year flood could result in approximately .12 fatalities to population projected in the period from 1992 to 1997 as a result of the project. There is a 1 percent chance of this occurring in any given year. It can be estimated that there is a 4.9 percent chance of the 100-year event occurring during this five-year period. This is a significant impact. | | | | |
| Remaining Flood Plain Area: The 100-year flood could result in approximately 2 fatalities out of the population projected in the period from 1992 to 1997 as a result of the project. There is a 1 percent chance of this occurring in any given year. It can be estimated that there is a 4.9 percent chance of the 100-year event occurring during this five-year period. | | | | |
| Additional Upstream Storage and Levee Improvement | | | | |
| Natomas: The 100-year flood could result in approximately .51 fatalities per year out of the population as a result of the project, for | S/U | 25. Please refer to Mitigation Measures 17 to 23 for mitigation measures for these impacts. | | |

N/A - Not Applicable
LTS - Less Than Significant
S/A - Significant Avoidable
S/U - Significant Unavoidable

None - No Impacts
REC/MAG - Recommended to Reduce Magnitude of Impact
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| Impact | Significance of Impact | Mitigation | Type of Mitigation Measure | Implementing Party |
|--|------------------------|------------|----------------------------|--------------------|
| each year after 1997 that flood protection measures providing 100-year protection are not implemented. There is a 1 percent chance of this occurring in any given year. | | | | |
| The Pocket Area: The 100-year flood could result in approximately .003 fatalities per year out of the population as a result of the project, for each year after 1997 that flood protection measures providing 100-year protection are not implemented. There is a 1 percent chance of this occurring in any given year. | | | | |
| Remaining Flood Plain Area: The 100-year flood could result in approximately .47 fatalities per year out of the population as a result of the project, for each year after 1997 that flood protection measures providing 100-year protection are not implemented. There is a 1 percent chance of this occurring in any given year. | | | | |

N/A - Not Applicable
LTS - Less Than Significant
S/A - Significant Avoidable
S/U - Significant Unavoidable

None - No Impacts
REC/MAG - Recommended to Reduce Magnitude of Impact
REDUCE/MAG - Would Reduce Magnitude of Impact, But Would Not Make Less Than Significant
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3. PROJECT DESCRIPTION

3. PROJECT DESCRIPTION

Introduction to the Project Description

The "project" under evaluation in this Environmental Impact Report (EIR) is a proposed land use planning policy (hereinafter the "Proposed Land Use Policy") for the 100-year flood plain identified on the May 1989 Preliminary Flood Insurance Rate Map (FIRM) (see Figure 1) and the Sacramento River Levee Failure Flood Potential Map (see Figure 2) attached to the policy (the original text of the policy is included in Appendix A). As described below, the project location refers to the areas which would be affected by the policy; the project objectives refer to the objectives of the City and County in implementing the policy; the project characteristics are the specific elements of the Proposed Land Use policy; and project approvals refer to actions which must be taken by the City or the County in order to fully implement the policy.

Additional information is provided on the historical background of the proposed policy and on the various assumptions regarding anticipated flood protection efforts which have shaped the proposed policy.

Project Location

The proposed policy would apply to all development in areas of the City of Sacramento and Sacramento County located in the 100-year flood plain identified on the May 1989 Preliminary FIRM (see Figure 1) and the Sacramento River Levee Failure Flood Potential Map (see Figure 2) attached to the policy.

Project Objectives

The City and County of Sacramento have several objectives in proposing the policy. These objectives include the following:

- ✧ To comply with the intent and spirit of the Special Legislation.
- ✧ To avoid undue exposure to the risks of floods.
- ✧ To minimize potential disruption in the Sacramento region and to avoid the precipitous break-up of the political, institutional, and economic relationships sustaining the high level, comprehensive, flood protection effort.

100-Year Flood Plain

100-year flood plain (A99 zone)

Flood Zone Continues Eastward to Nimbus Dam

Figure 1

Source: FEMA, EIP Associates, 1989

100-Year Flood Plain

100-year flood plain (A99 zone)

Flood Zone Continues Eastward to Nimbus Dam

Figure 1

Source: FEMA, EIP Associates, 1989

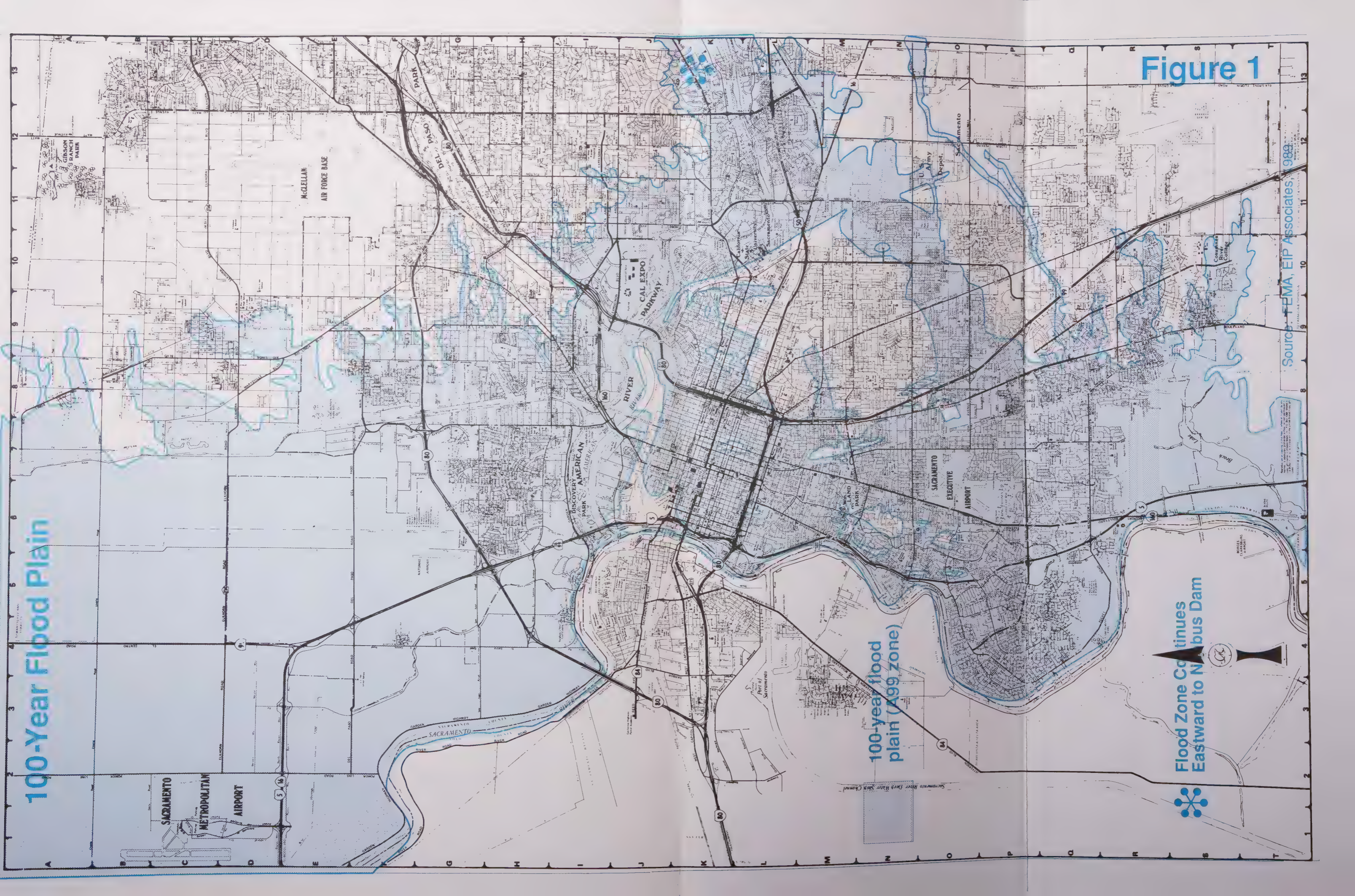
100-Year Flood Plain

100-year flood plain (A99 zone)

Flood Zone Continues Eastward to Nimbus Dam

Figure 1

Source: FEMA, EIP Associates, 1989

[illegible]

100-Year Flood Plain

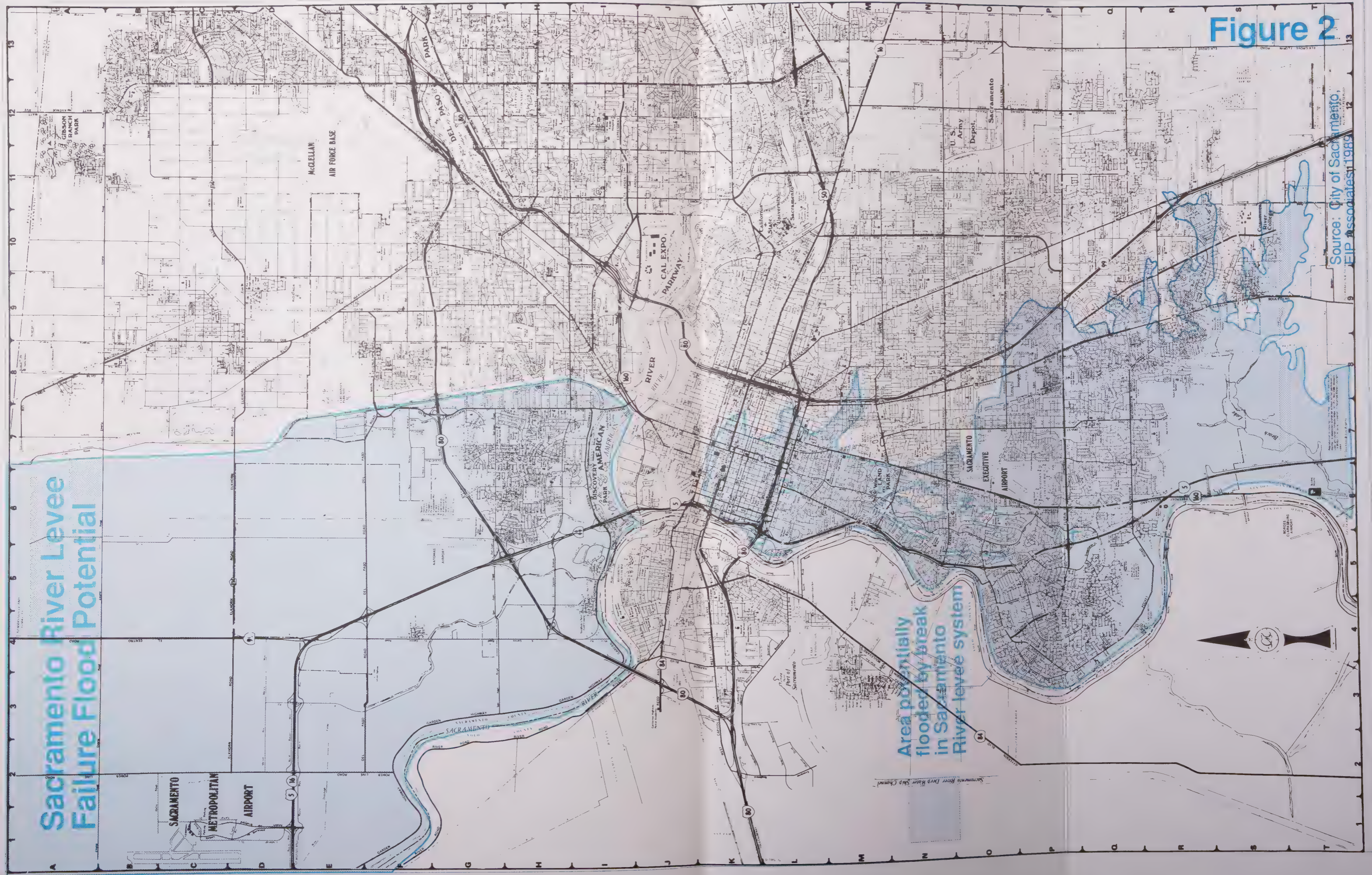
100-year flood plain (A99 zone)

Flood Zone Continues Eastward to Nimbus Dam

Figure 1

Source: FEMA, EIP Associates, 1989

Sacramento River Levee Failure Flood Potential



Source: City of Sacramento, EIP Associates 1989

Figure 2

Description of the Proposed Land Use Policy

The Task Force has presented the City and County with a set of proposed policies related to land use and notification which, it believes, responds to the requirements of the flood protection provisions of the McKinney Homeless Assistance Act of 1988 (H.R. 524) "Special Legislation." The Proposed Land Use Policy contains five specific elements which identify the type and timing of development which would be permitted within the flood plain. The Task Force has recommended that four of these elements be in place "until approximately July 1, 1990 and until the City Council and Board of Supervisors determine that the nature of the flood risk is acceptable for their respective jurisdictions." The Task Force staff anticipates recommending that the City Council and the Board of Supervisors rescind these elements, with the exception of the Change of Land Use element, once contracts for levee stabilization have been awarded and the decision makers determine, at their discretion, that the flood risk is acceptable.

The Five Elements of the Proposed Land Use Policy contains the following five elements:

▣ Change of Land Use

"The City and County reaffirm their commitment to Congress not to designate any increases in urbanization beyond lands already so designated in the City's General Plan or in the County's pending General Plan update during the period covered by the Special Legislation. It is, however, understood that annexations where no increases in urbanization are contemplated will be processed. The County's General Plan is being prepared with the full knowledge of the flooding issues identified by the USCOE and the strategies and programs being developed by the City/County Office of Flood Control Planning. Policies will be developed for inclusion in the General Plan which support these strategies and which will prohibit construction in any flood hazard area until flood solutions are in place. Approval of General Plan designations will not automatically result in the ability to secure building permits consistent with those designations. Property owners must file and secure approval of zoning classifications which are consistent with General Plan designations. In addition to this commitment, applications for zoning or pre-zoning changes within the flood plain and not consistent with existing City and County General Plans from agricultural to urban use will not be approved during the period covered by the Special Legislation approval by Congress in 1988."

The following four policy elements apply only to that portion of the 100-year flood plain designated as the Sacramento River Levee Failure Flood Potential Map, shown in Figure 2 (a detailed description of the likely events surrounding a levee failure are included in Environmental Setting, Chapter 4, pages 56 to 63). These elements will remain in effect until construction contracts for levee stabilization are awarded and the City Council and Board of Supervisors determine that the flood risk is acceptable.

✧ Discretionary Entitlements For Residential Projects That Have Been Filed After April 1, 1989

"Tentative and final maps and other discretionary entitlements will continue to be processed. However, no building permits shall be approved by the City or County unless it can be shown that the project can be built in accordance with the USCOE January, 1989 Working Maps, and any other applicable City and County regulations. A note to this effect shall be placed on the final map. The City and County shall take the necessary steps to remove this note when appropriate."

✧ Discretionary Entitlements For Residential Projects That Have Been Filed By April 1, 1989

"Existing residential projects which have tentative maps, final maps, special permits or plan reviews which have been filed prior to April 1, 1989 will be allowed to proceed subject to the owners' signing all legal conditions and waivers as developed by the City Attorney's or County Counsel's Office prior to recordation of final map or issuance of building permit whichever occurs first."

✧ Development Agreements

"Property owners of properties under development agreements ('developers') have suggested that the agreements prohibit the City from delaying development of those properties until flood control measures are in place or contracted for. The City believes that the development agreement and federal authority may authorize the City to delay development until flood protection measures are in place or contracted for. Both the City and these developers agree that the flooding risk pertains to the construction of buildings, not the approval of development entitlements such as tentative subdivision maps, final maps or special permits. Hence, the City will review on a case-by-case basis requests for entitlements for property under development agreements. The City may require that the property be built in accordance with the USCOE January 1988 Working Maps, and other applicable City regulations."

✧ Non-Residential Buildings

"Non-residential buildings shall be designed by an architect or civil engineer so as to minimize the extent of structural damage sustained in the event of a 100-year flood. Design standards to be used for the City will be prepared by the City Building Inspections Division. Design standards for the County will be prepared by the County Public Works Department. Projects accepted for plan check prior to April 1, 1989 will be exempt from these requirements."

The City design standards are as follows:

- ✧ "Fully enclosed non-residential buildings that are subject to flooding shall be designed to equalize hydrostatic flood forces on the exterior walls by allowing for the entry and exit of flood water as follows:

"Openings covered by glazing or overhead doors may be assumed to allow entry and exit of flood water. These openings shall be provided at the rate of three square inches for each square foot of floor area. The location of the required openings shall be reasonably distributed along the perimeter of the building, and shall be located within two feet of the ground surface or west floor level.

Alternate means for entry and exit of flood water may be designed. Systems shall be sized to allow flood water to enter or exit at a sufficient rate to keep up with an external rise or drop in static head equal to one foot per hour. A static head differential of two feet may be assumed between interior and exterior water surfaces for design purposes."

- ✧ Policy Recommendation - City/Countywide

For the areas not affected by the Sacramento River levee system, no building permits for private projects (residential or non-residential) will be issued within the 100-year flood plain (as described in the January, 1989 USCOE information), unless all legal conditions and waivers as required by the City Attorney or County Counsel are executed by the property owner; or, it can be shown that the project can be built in accordance with the USCOE's January 1989 Working Maps, and other applicable City and County regulations.

Project Approvals

It is expected that the City Council and the Board of Supervisors will adopt the Proposed Land Use Policy as ordinances. It is further expected that those ordinances will be rescinded at some time in the future, at the discretion of each representative body.

This EIR will be published and circulated for public comment for a period of 45 days, from September 18 through November 1, 1989. Written comments from the public and other interested agencies may be submitted at any time during the comment period. There will be a public hearing on the Draft EIR before the City Council during the comment period. After the close of the comment period, the EIR authors will respond in writing to all comments submitted during the comment period and at the public hearing. The comments and responses will be published for review of the City Council prior to their action on certification of the EIR. The Draft EIR and the Comments and Responses, including any revisions of the Draft EIR contained therein, will constitute the Final EIR which the City Council will evaluate for certification as to its objectivity, accuracy, and completeness.

4. ENVIRONMENTAL SETTING

4.1 HYDROLOGY OF THE SACRAMENTO AND AMERICAN RIVERS

The Sacramento Basin is bounded by the Sierra Nevada on the east, the Coast Ranges on the west, the Cascade Range and Trinity Mountains on the north, and the Delta-Central Sierra area on the south. A portion of the watershed of the Pit River, the most northerly tributary of the Sacramento River, lies north of the basin in Oregon, but drains from Goose Lake through the Cascade Range into the Sacramento Basin proper. The Sacramento Basin is about 280 miles long and up to 150 miles wide and has a land area of 26,500 square miles and a water area of 400 square miles.

The Sacramento River is the principal stream in the basin. Its major tributaries are the Pit and McCloud Rivers, which join the Sacramento River from the north, and the Feather and American Rivers, which are tributaries from the east. Numerous tributary creeks flow from the east and west. The average runoff from the basin is second only to the North Coastal Basins and is estimated at 21.3 million acre-feet per year. The melting snowpack in the Sierra Nevada maintains streamflow during most of the summer.

Figure 3 shows the entire Sacramento River Basin and the location of major projects that can affect storm water flows in the Sacramento and American rivers. The projects shown are listed on the following project index.

※ NAVIGATION

- 100 Feather River
- 101 Sacramento River, Shallow Draft Channels
- 102 Sacramento River, Deep Water Ship Channel

※ MULTIPURPOSE

- 103 Shasta Lake (Cooperative Project)
- 104 Cottonwood Creek Project
- 105 Black Butte Lake
- 106 Lake Oroville (Cooperative Project)
- 107 New Bullards Bar Reservoir (Cooperative Project)
- 108 Lakeport Lake
- 109 Marysville Lake
- 110 Folsom Lake

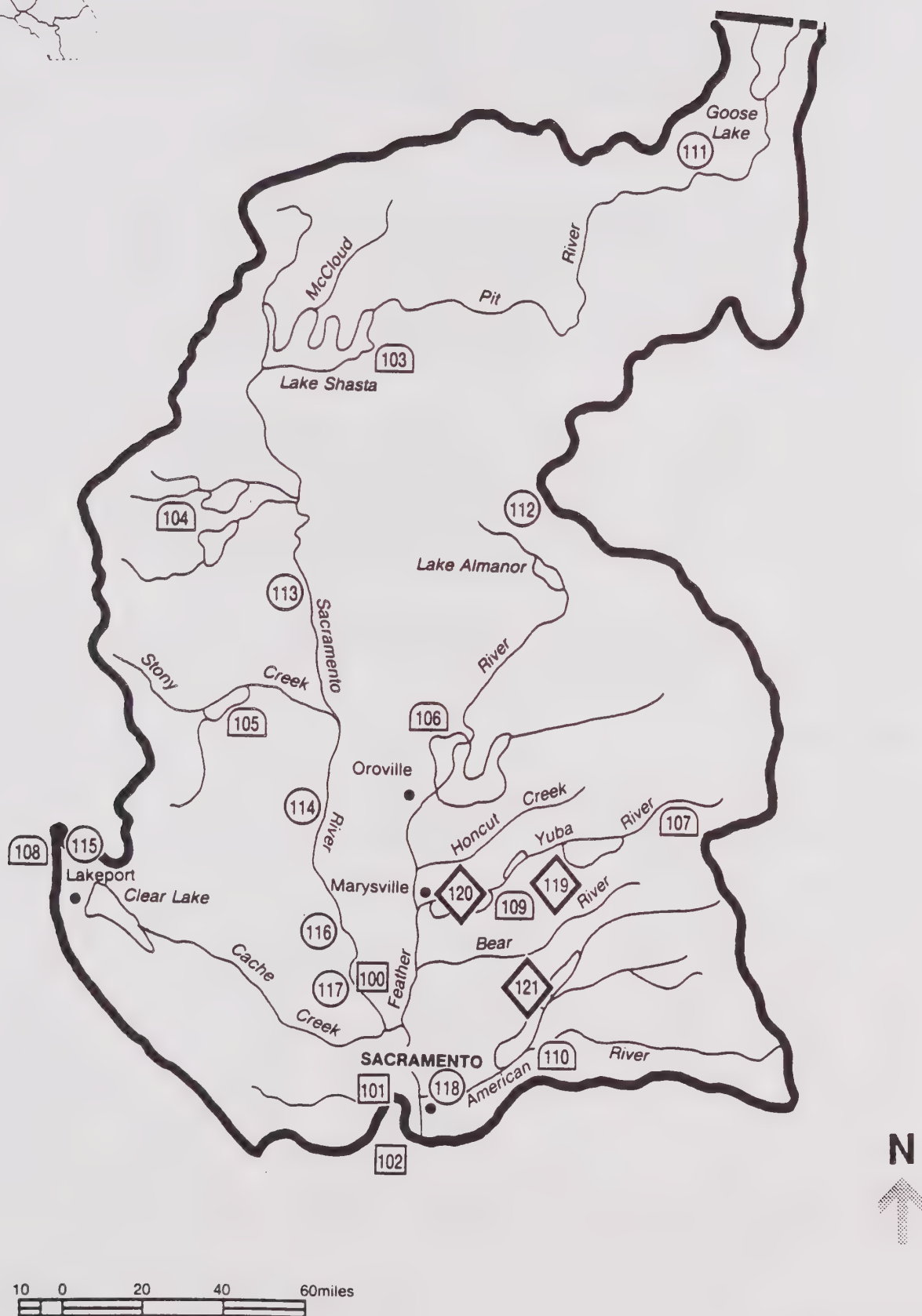
※ FLOOD CONTROL

- 111 North Fork Pit River at Alturas (Small Flood Control Project)
- 112 North Fork Feather River at Chester



Sacramento Basin

Figure 3



Source: USCOE, 1987

- 113 Sacramento River, Chico Landing to Red Bluff
- 114 Sacramento River and Major and Minor Tributaries
- 115 Middle Creek
- 116 Sacramento River Bank Protection
- 117 Sacramento River
- 118 American River Levee

✱ **DEBRIS CONTROL**

- 119 Harry I. Englebright Lake
- 120 Yuba River Restraining Barriers
- 121 North Fork Lake

The Sacramento River Tributary Watershed area above Verona (located approximately 18 river miles above "I" Street) is 21,300 square miles, and the Sacramento River Tributary Watershed area between Verona and "I" Street is 23,500 square miles.

The American River watershed area as shown on Figure 4 is 1,890 square miles at Nimbus Dam and 2,150 square miles at the mouth.

Average annual precipitation in the Sacramento River Basin ranges from approximately 14 inches in the valley north of Sacramento near Colusa to as high as 90 inches at localized areas in the Sierra Nevada mountains northeast of Oroville. In the American River Basin the rainfall ranges from approximately 18 inches in the Sacramento area to in excess of 80 inches in the Sierra northeast of Sacramento in the Blue Canyon area.

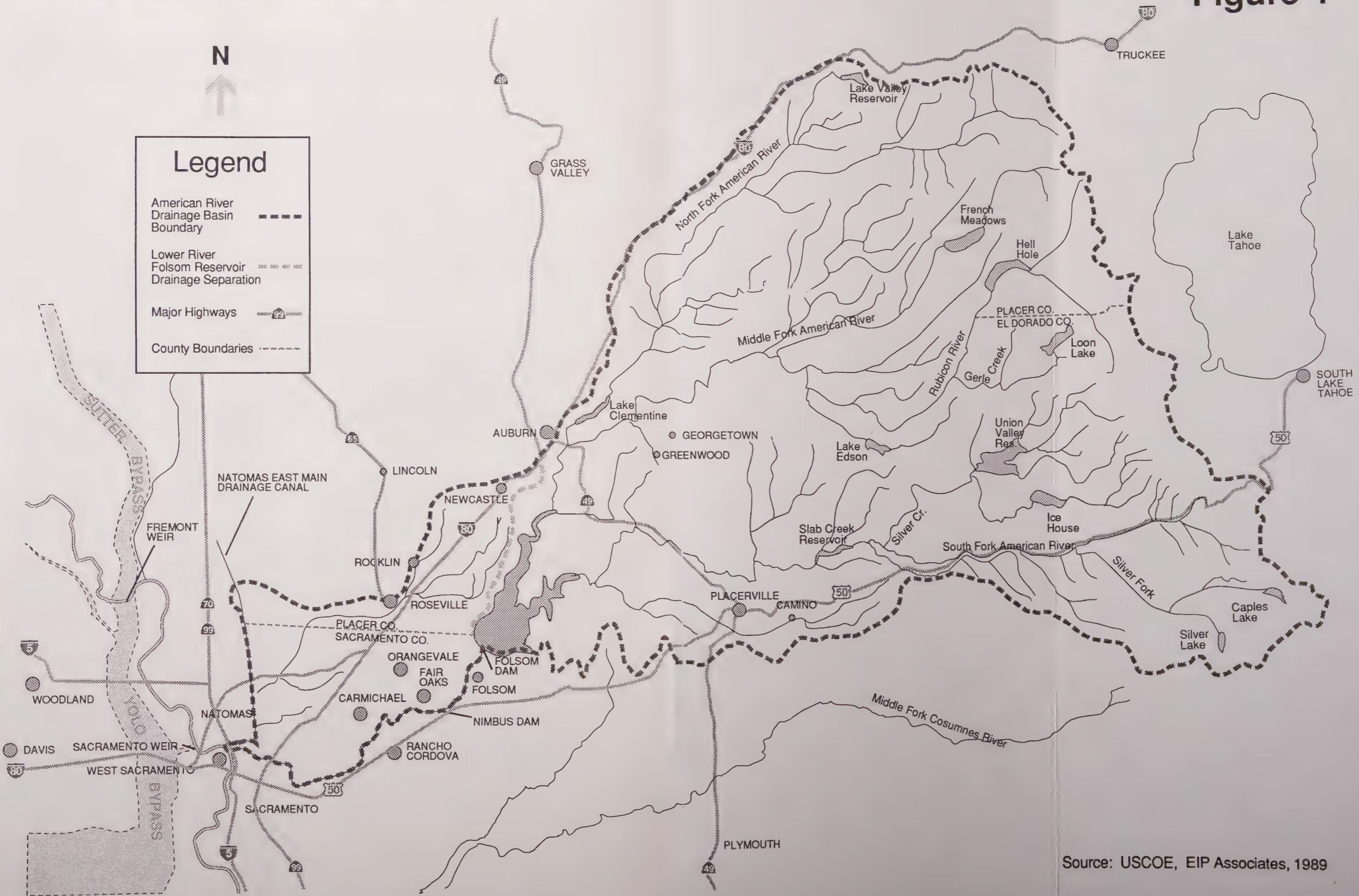
Storms that have resulted in floods are generally of a duration of one to two weeks. For example, the February 1986 storm lasted approximately 9 to 10 days and produced nearly 10 inches of rainfall in the Sacramento area, and as much as 50 inches near Bucks Lake in the Feather River watershed.

Major flood-producing storms over the Sacramento and American River Basins are generally associated with storm systems that originate between 30 and 50 degrees north latitude and develop a moist air influx trajectory from the latitude of the Hawaiian Islands. As the air mass approaches the Coast Range from the west, the air is lifted, causing it to cool and release its moisture in the form of precipitation. This lifting effect combined with some convergence accounts for the major portion of the central California precipitation.

Large flood flows in the Sacramento River Basin, above the Feather River, occur as a result of general rainstorms. The floods of January 1970 and March 1983 are good examples of this. Large flood flows in the Feather and American River Basins generally result from a combination of general rain and snowmelt runoff, as in February 1986 and December 1964 through January 1965.

American River Watershed

Figure 4



Source: USCOE, EIP Associates, 1989

During major flood events, high flows can occur throughout the Sacramento and American river system. The relative timing of these flows can accentuate the flood risk since the high water levels in a primary stream can result in a "backwater" effect which reduces the effective slope and capacity of the tributary or incoming stream.

An example of this effect would be the lower reach of the American River. The flood water surface elevations in the American are "controlled" or effected by the Sacramento River water surface elevation either at the mouth of the American or at the Sacramento Weir. Under most conditions the water surface in the American "backs up" from its mouth; however, during maximum peak flows, there is actually a "flow reversal" when a portion of the flow from the American moves upstream in the Sacramento River to the Sacramento Weir. Numerous other local flood control and drainage facilities are also impacted by the high water levels in the main channels. The flood water levels in the NEMDC are controlled by the "back up" from the American River. In turn, the water levels in Dry Creek and other tributaries to the NEMDC are affected by the water surface in this canal. The capabilities on other tributary streams such as the Chicken Ranch Slough area also are affected by the water levels in the American River.

Due to the relatively flat terrain of the Central Valley, this "backwater" effect is a significant controlling factor for most natural streams and flood control or drainage channels in the region. This effect was significantly demonstrated during the February 1986 flood event which was characterized by the long duration of the storm that caused high water levels in the primary streams. Near the end of this storm period, an intense period of precipitation was experienced resulting in high runoff that could not be adequately handled due to the "backwater effect" of the primary streams that were already at high levels.

4.2 HISTORY OF FLOODING AND FLOOD CONTROL IN SACRAMENTO

Sacramento has been subject to flooding or risk of flooding since its founding. This was recognized by Captain John Sutter and his founding party of settlers who located their fort on a small knoll at an elevation of between 5 and 10 feet above the surrounding area.

The first major recorded flood occurred in January 1850. This flood resulted from extended periodic rains that started in mid-November 1849 and continued into January 1850. The American River overtopped its banks on January 8, as did the Sacramento River a short time later. Most of the City had been inundated for up to 10 days by the time the water had receded.

It was reported that entire developed portions of the City were flooded. Those residents with two story accommodations remained in the City. However, a significant portion of the population evacuated to high ground. The short-lived community of "Hoboken" was formed by evacuees near the present site of California State University. In response to this flood event, levees were constructed along the American and Sacramento rivers. However, this proved to be inadequate and the City was again subject to major flooding in 1852.

Flooding and remedial levee construction continued until the great flood of 1861-62. During December 1861 and January 1862 over 23 inches of rain were measured in Sacramento and 104 inches in Nevada City. Flooding started with a breach of the American River levee in early December and continued through nearly the end of January. Major destruction of property and loss of life was recorded.

As a result of the 1862 event, the City initiated the actual raising of developed areas from the Sacramento River to as far east as 12th Street. Streets were raised up to 10 feet or about two feet above the 1862 high water marks. For many multistory buildings, the first floor levels were converted to basements while other buildings were jacked up to the new street levels. This effort began in 1863 and continued for approximately 10 years.

Another major project completed during the 1860s was the rerouting of the American River channel at two locations to remove severe bends that had been points of breakouts on several occasions. These were near the present City landfill at 28th and "B" Streets and near the mouth of the river at the present site of Discovery Park.

The Sacramento Valley suffered a number of serious flood events in the late 19th Century, especially 1879, which prompted the State Legislature to take charge of flood control works in the Sacramento Valley in an effort to find regional solutions to flood control problems. The Swamp Land Reclamation efforts further compounded flooding problems as it removed overflow land areas for agricultural purposes. This further concentrated flows in already inadequate river channels. Hydraulic mining

operations had allowed large volumes of sediment from upstream tributaries to accumulate in the rivers, further choking off the river capacities. At the mouth of the Yuba River, the sediments raised the stream bed elevation 13 to 15 feet above the pre-mining days. The Feather River reduced the waterway area of the Sacramento River below the mouth of the Feather River to less than 2/3 of the original capacity available at the historic bank full stage.

The State Legislature in 1880 realized their regional responsibilities and created the Board of Drainage Commissioners. The "Sawyer Decision" stopped hydraulic mining in 1884. The floods of 1879 and 1894 caused the State to ask the Federal government to share in the responsibility of finding a regional solution to the flooding and navigation problems found in the valley. President Cleveland created and appointed the California Debris Commission (CDC) on May 3, 1893. The CDC was composed of three USCOE officers who were given the responsibility to improve navigability on all rivers comprising the valley system, deepen their channels and protect their banks and regulate and permit hydraulic mining in the state. This Commission evaluated the entire system and submitted a report for comprehensive improvements to include the weirs and bypasses to the Congress of the United States in the "Jackson Report." The Congress approved the plan in the River and Harbor Act of 1910.

The State formally adopted the plan for flood control of the Sacramento River by Legislative Act in December 1911. This act also created the California State Reclamation Board with unusual powers to ensure the carrying out of that plan. The Reclamation Board was directed in that legislation to be the local sponsor for any future Federal projects. The Federal and State legislations were revised in 1913 and 1915, respectively, to more clearly spell out Federal and State cost-sharing responsibilities.

The State increased the Board's responsibilities in 1913 by creating the Sacramento-San Joaquin Flood Control District. The Congress determined that the Federal government had an interest in finding comprehensive flood control solutions in the region by passing the Flood Control Act of 1917. This act fixed the degree of participation in the cost of the project by the State and Federal governments. The Jackson Report had been a bare bones approach to finding regional flood control solutions to capacity and debris problems and, therefore, the Congress charged the CDC to conduct a more comprehensive review of the plan and system. The CDC submitted to Congress in 1925 the "Grant Report" outlining a comprehensive approach to develop the valley's flood control systems. The River and Harbor Act of May 15, 1928 adopted the Grant Report.

The Grant Report made it very clear that modifications and step-by-step construction of the entire Sacramento River Flood Control Project were to be made as an ongoing cooperative effort between Federal and State entities. Therefore, Federal and State agencies were to cooperate in the restoration and improvement of existing levees and the construction of new levees on a continuous basis. The primary recommendation of the report was construction of a system of overflow weirs and leveed bypasses which removed flows from the rivers during major events thereby leaving only the flows in the river that the natural channel could carry. This system included the Sutter, Tisdale and Yolo bypasses and the Colusa, Tisdale, Moulton, Fremont, and Sacramento weirs, which are shown on Figure 5.

Lower Sacramento River Flood Control Projects

Figure 5



The bypass and levee system was followed by major multipurpose dams at Shasta, Oroville, and Folsom.

In addition to the facilities discussed there are numerous local flood control channel and levee systems that provide flood protection to the Sacramento area. A portion of these are shown on Figure 6.

Even with the completion of the numerous facilities discussed above, a flood risk remains for the Sacramento area.

Large floods have occurred within the region during recent history. These include December 1955, December 1964, January 1969, January 1970, December 1982, and February 1986. Table 2 shows the approximate peak flows of these flood events on the Sacramento River at "I" Street. The flood flows from these storms were controlled to generally safe levels. During the 1955 storm, the newly completed and nearly empty Folsom Dam and reservoir controlled American River flows.

In 1986, water levels reached elevations above the levels considered to be safe. Even though no complete failures of the system were experienced, the levee came within inches of being over-topped on NEMDC, and there was partial failure at several locations along the Garden Highway levees. Without the flood fighting effort that occurred during this major flood event, total failure of the Garden Highway levees might have occurred.

The February 1986 Flood

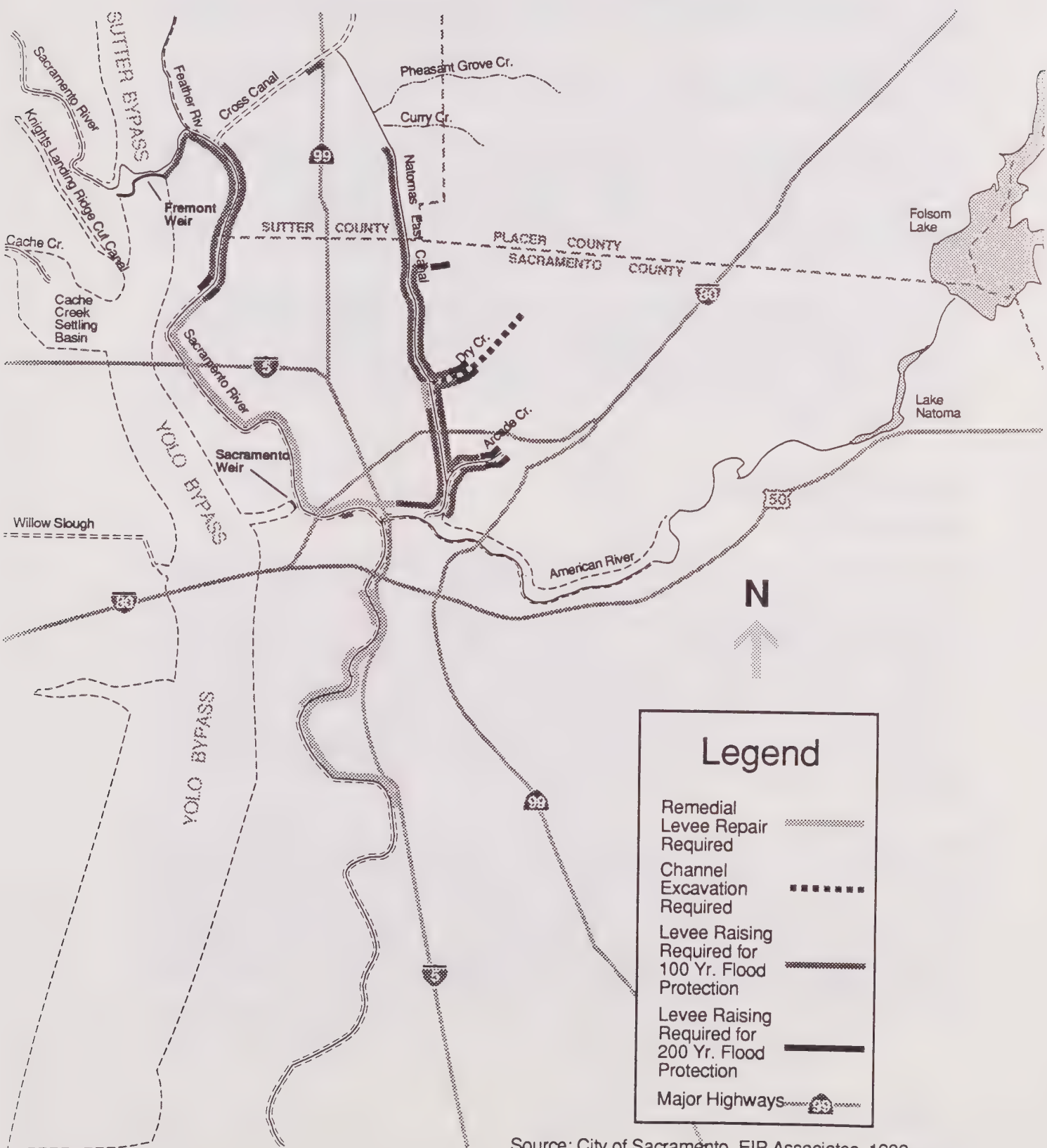
Statewide Impacts

The series of storms that struck California in February 1986 resulted in the "flood of record" for many parts of northern and central California. The "flood of record" is defined as the largest flood flows that have occurred since official records have been maintained, generally dating back to the early 1900s. Major streams affected were the Sacramento, Feather, Yuba, American, Napa, Cosumnes, Mokelumne, Petaluma, and Russian rivers. Heavy rains and flooding continued for more than a week from the Northern California coast to the San Joaquin Valley. Precipitation totals for the 10-day storm were more than half of the normal year's supply of rain for much of California. The Sacramento region was in the center of the path of storms that originated in the Pacific, pushing the flood control system to its capacity and beyond.

Record high flows saturated much of the levee embankment system, compromising the structural integrity of the levees, while severe winds often drove the waves over the top of levee embankments. Emergency crews worked around the clock, patrolling and repairing damaged levees throughout the system. Levee breaks and/or the threat of levee failure led to emergency evacuation procedures in many counties around the state including Sacramento, Sutter, Yuba, Placer Counties and several islands in the Delta. Near Rio Vista, California, flood waters contributed to a high tide reading almost two feet greater than ever recorded.

Necessary Future Flood Control Improvements

Figure 6



Source: City of Sacramento, EIP Associates, 1989

TABLE 2**ESTIMATED PEAK FLOWS OF HISTORIC FLOOD EVENTS ON THE
SACRAMENTO RIVER AT "I" STREET¹**

| Date of Flood Event | Flow (cfs) |
|---------------------|----------------------|
| December 1955 | 95,000 |
| December 1964 | 100,000 |
| January 1969 | 96,000 |
| January 1970 | 94,000 |
| December 1982 | 98,000 ² |
| February 1986 | 117,000 ² |

¹ Design flow of the Sacramento River at "I" Street is 110,000 cfs.

² Measurement taken downstream of "I" Street on the Sacramento River at Freeport.

SOURCE: USCOE, February 1989.

Emergency levee work prevented catastrophic flooding in many places, including the Sutter bypass levee near Robbins. However, in spite of diligent levee patrolling and emergency levee work, levees failed on Yankee Slough in Sutter County, along the Yuba River opposite Marysville, and along several islands in the Delta.

Highway and road closures due to high water, slides, and snow isolated many communities. An Eel River bridge at Rio Dell on the north coast collapsed as a crane removed debris jammed against its supports. Interstate 5 from Sacramento to Lodi was closed for nearly three weeks.

When the storm was finished, the Governor had proclaimed emergencies in 39 counties and damages totaled more than half a billion dollars. Preliminary damage estimates from the State Office of Emergency Services (OES) by county were tabulated (see Table 3).

Statewide flood damage estimates indicated that 12 deaths were attributed to the February 1986 storm along with 67 injuries. More than 50,000 people were forced from their homes. Property damages included approximately 12,500 houses and 1,000 businesses damaged, and 1,400 houses and 200 businesses destroyed.

Regional Impacts

A significant characteristic of the February 1986 storm in the Sacramento area that contributed to severity of the flood risk was its long duration and the timing of the intense periods of rainfall in the watershed area. The most intense rainfall during the storm occurred on February 18. It was preceded by nearly continuous rainfall of varying intensity since February 11. Prior to the major storm period, rainfall had occurred during the period from January 31 to February 3. The intense period of rainfall on February 18 resulted in significant flooding or flood risk since it occurred after the watershed area had been saturated, reservoirs nearly filled, and the major river and bypass channels were flowing at or near capacity.

The more significant local events included, on February 18, the cofferdam at the Auburn site, upstream on the North Fork of the American River giving way (as designed), adding 120,000 acre-feet of water to Folsom Lake. In the area north of the American River, Dry Creek flooded Rio Linda, forcing 200 homes to be evacuated. Boils (the discharge of seepage carrying earth material on the landside of a levee) were seen forming behind the American and Sacramento river levees. Emergency work included sandbagging rings around boils to prevent levee failure. The communities of Pleasant Grove and Elverta, just east and north of Natomas, were flooded. On February 19, the State fairgrounds and some apartment complexes were flooded in Sacramento. More than 700 people were evacuated and areawide evacuation plans were readied. Arcade Creek flooded parts of North Sacramento, and sections of Roseville were flooded by Dry and Linda creeks. On February 20, levees along the Sacramento River, near the Garden Highway, showed signs of weakening. Emergency crews moved in to shore up and protect North Natomas. On February 21, boils and seeps continued to be found along the American and Sacramento rivers. Several boils were reported along the Garden Highway and in South Sacramento.

TABLE 3**ESTIMATED DAMAGES BY COUNTY FOR FEBRUARY 1986 FLOOD**

| County | Damages in Millions of Dollars |
|------------|-----------------------------------|
| Napa | 50 |
| Sacramento | 49 |
| Sonoma | 40 |
| Solano | 27 |
| Yuba | 23 |
| Sutter | 20 |
| Placer | 16 |
| Butte | 15 |

SOURCE: USCOE, February 1989

During the 1986 flood, in the area north of Sacramento, many of the streams had individual flows lower than design capacity and below the maximum flow of record and the safe channel designs. However, nearly all these flows coincided with the peak flows from the other local tributary streams, resulting in flows and maximum stages of water surface elevations that exceeded maximum recorded and safe design levels at many downstream locations.

The peak releases from Folsom reservoir were as high as 134,000 cfs or over 17 percent more than the flow for which the American River levee system is designed. The Sacramento River, Yolo Bypass, and Sacramento Bypass flows also approached or exceeded safe design flows in 1986 (see Table 4).

February 1986 water surface elevations were dangerously close to the top of the levee in many parts of the study area. Surveyed high water mark information was compared to surveyed levee crown elevations to determine the freeboard (difference between the high water mark and the levee crown elevations) remaining during the 1986 flood event. Design freeboard for the Sacramento River is three feet and for the Yolo Bypass is six feet (to account for wave action). In 1986, high water levels were encroaching into the design freeboard in many locations throughout the system. Figure 7 indicates the freeboards measured at various reaches of the levee system during the 1986 flow.

High flows during the 1986 flood event took their toll on the structural integrity of the levee system. Numerous boils, slips, sloughing, seepage, floodflow erosion and wave erosion required emergency work by Federal, State, and local agencies to minimize or prevent further damage during the flood.

High water combined with wave action caused extensive erosion damage to the Yolo Bypass levee system. Local observers reported waves up to six feet in the Yolo Bypass. Emergency sandbagging was necessary to keep the water from overtopping the levee embankment into the West Sacramento area. Many of these sites required emergency placement of plastic, rock riprap or fill material over the damaged areas during the flood. Some Sacramento River levees also suffered wave erosion damage. On the east bank of the Sacramento River, emergency sandbagging was needed along openings in the floodwall between "I" Street and the Tower Bridge.

Although Sacramento River levees suffered damage due to wave erosion, the majority of the problem areas were associated with the seepage of water through the levee and landside subsidence, slippage, or sloughing. Wave wash, flow through and under the levees, and landslide sloughing were common. Many areas required emergency sandbagging around boils, placement of drainpipe or fill material, and post-flood repair.

TABLE 4

COMPARISON OF DESIGN FLOWS AND STAGES AND PEAK FLOWS
AND STAGES DURING FEBRUARY 1986 FLOOD

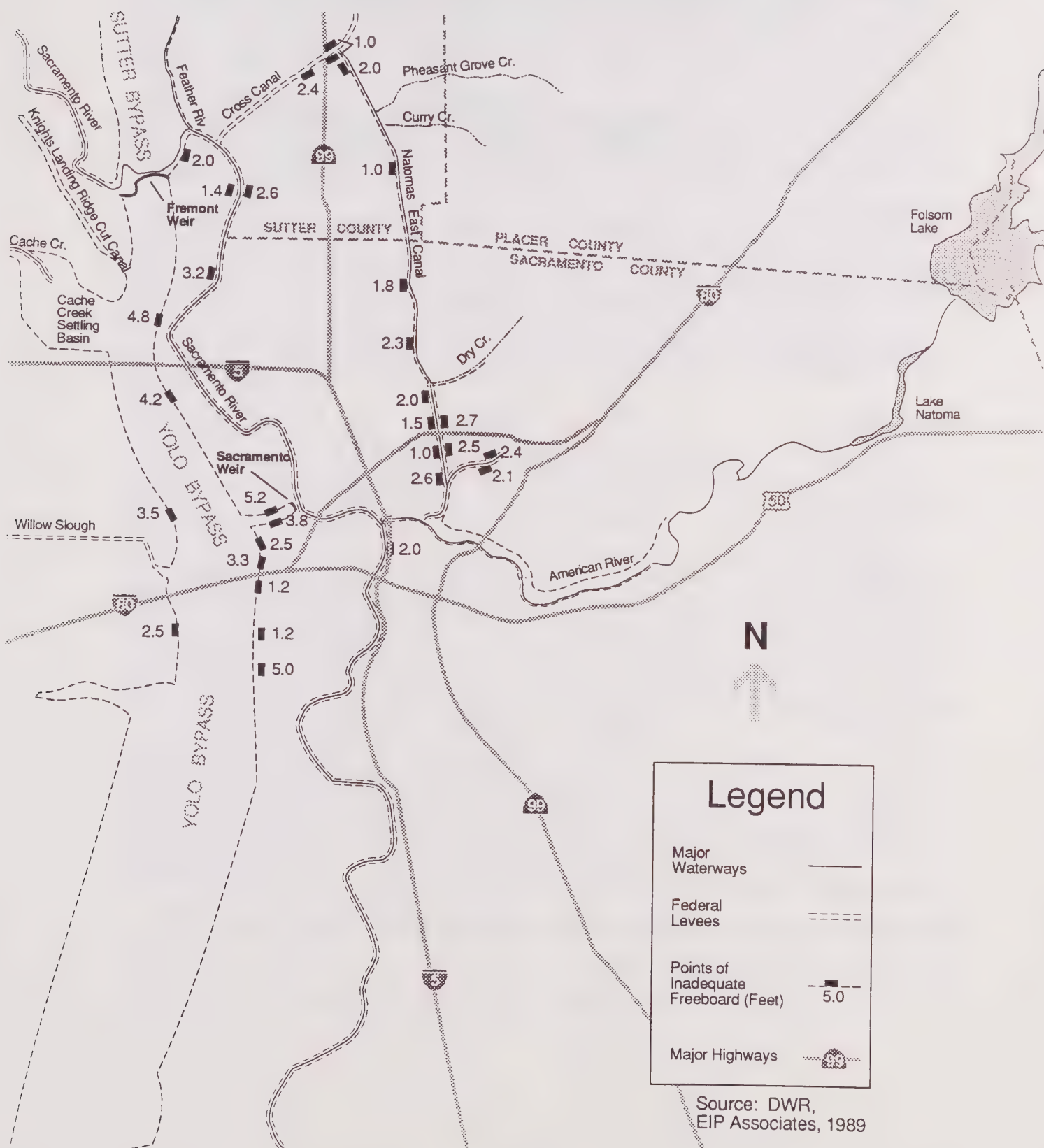
| Location | Design Flow (cfs) | February 1986 | | Design Stage (msl) ¹ | February 1986 Peak Stage (msl) |
|---|----------------------|--------------------------------------|--|------------------------------------|--------------------------------------|
| | | Peak Flow (cfs) | | | |
| Sacramento River at Verona | 107,000 | 92,900 | | 38.2 | 39.11 |
| Sacramento River Fremont Weir Spill | 343,000 | 341,000 | | 37.8 ² | 38.54 ³ |
| Yolo Bypass near Woodland | 377,000 | 374,000 | | 31.3 | 31.46 |
| Yolo Bypass near Lisbon | 490,000 | 495,000 to 509,000 (estimated) | | 23.2 | 24.88 |
| Sacramento River Sacramento Weir Spill | 112,000 | 127,680 | | 31.5 ² | 30.56 ³ |
| Sacramento River at Bryte | | | | 31.5 | 30.65 |
| Sacramento River at "I" Street | | | | 31.1 | 30.58 |
| Sacramento River at Freeport | 110,000 | 117,000 | | 25.4 | 25.11 |

¹ msl - Mean Sea Level² Design stage of Sacramento River opposite location of weir.³ Observed water surface elevation on Sacramento River 550 feet upstream of weir.

SOURCE: USCOE, February 1989.

Points of Inadequate Freeboard During February 1986 Flood

Figure 7



In February 1986, The Sacramento Weir and Bypass suffered scour damage to the concrete apron just downstream of the weir. This was associated with high flows and velocities. Erosion and undercutting damaged the concrete pavement protecting the weir structure as well as the south levee embankment of the Sacramento Bypass. Seepage was also observed along both north and south levees of the bypass while damage from wave erosion occurred where the Sacramento and Yolo Bypass levees intersect.

Although the 1986 flood was a major event, no complete levee failures were experienced in the Sacramento area. However, problems that occurred and required flood fighting indicate that similar or larger floods could produce catastrophic property damage and loss of life.

4.3 RESPONSE TO FLOODING CONCERNS

Current Responses to Flooding Concerns

In response to the 1986 floods Federal, State, and local governmental agencies responded to the flooding concerns in the Sacramento area in various ways. These include:

- ✧ Cooperative planning effort to develop plans for long-term flood protection measures.
- ✧ Repair of damages to levees and channels that occurred during the 1986 flood event.
- ✧ Temporary adjustment of the operation of Folsom Dam.
- ✧ Preparation of flood inundation and threat studies and emergency plans.
- ✧ Legislative action authorizing continued limited construction activity in the designated flood plain areas.
- ✧ Establishing the Sacramento Metropolitan Flood Protection Task Force to oversee and coordinate Sacramento efforts to achieve effective flood protection.
- ✧ Construction of flood control gates at various locations throughout the system.

Cooperative planning effort to develop plans for long-term flood protection measures

Cooperative planning studies to identify long-term flood protection measures have been undertaken by the USCOE, U.S. Bureau of Reclamation, California Department of Water Resources, State Reclamation Board, City of Sacramento, and the County of Sacramento. Furthermore, an Office of Flood Control Planning was created to coordinate local agency concerns and establish a financial mechanism to promote flood control improvements. A joint task force has been formed to coordinate this effort. The USCOE has had the primary responsibility for the technical planning effort. The ongoing studies being conducted by the USCOE include:

Sacramento River Flood Control System Evaluation
 Folsom Reoperation Study
 Sacramento Metropolitan Area Study
 American River Watershed Investigation

Dry Creek Studies
Morrison Creek Stream Group Studies
Auburn Dam

A brief description of each of these follows.

Sacramento River Flood Control System Evaluation

This is a comprehensive five-phase study of the entire Sacramento River Flood Control System between Red Bluff and Collinsville in the Delta. This study focuses on latent construction defects and structural adequacy of the existing levees. Phase 1 of this evaluation, which addressed the Sacramento River levees that protect the Sacramento metropolitan area, has been completed. This study determined that 32 of the 110 miles of levee system in the area (as shown on Figure 8) require remedial work to correct latent construction defects. Design engineering has been initiated and it is anticipated that the remedial work will start in 1990. It is anticipated that the entire five-phase study will be completed in 1992. The State Reclamation Board and Department of Water Resources are participating in these studies.

Folsom Reoperation Study

The USCOE, in cooperation with the U.S. Bureau of Reclamation, is studying the potential for modifying the operational criteria for Folsom to provide an additional 100,000 to 250,000 acre-feet of flood control storage space. This additional storage would allow the flood control flow releases in the American River to be held to 115,000 cfs, which is the design objective of Folsom Dam. A draft of this study report is scheduled for completion in October 1989 with a final report by the spring of 1990.

Sacramento Metropolitan Area Study

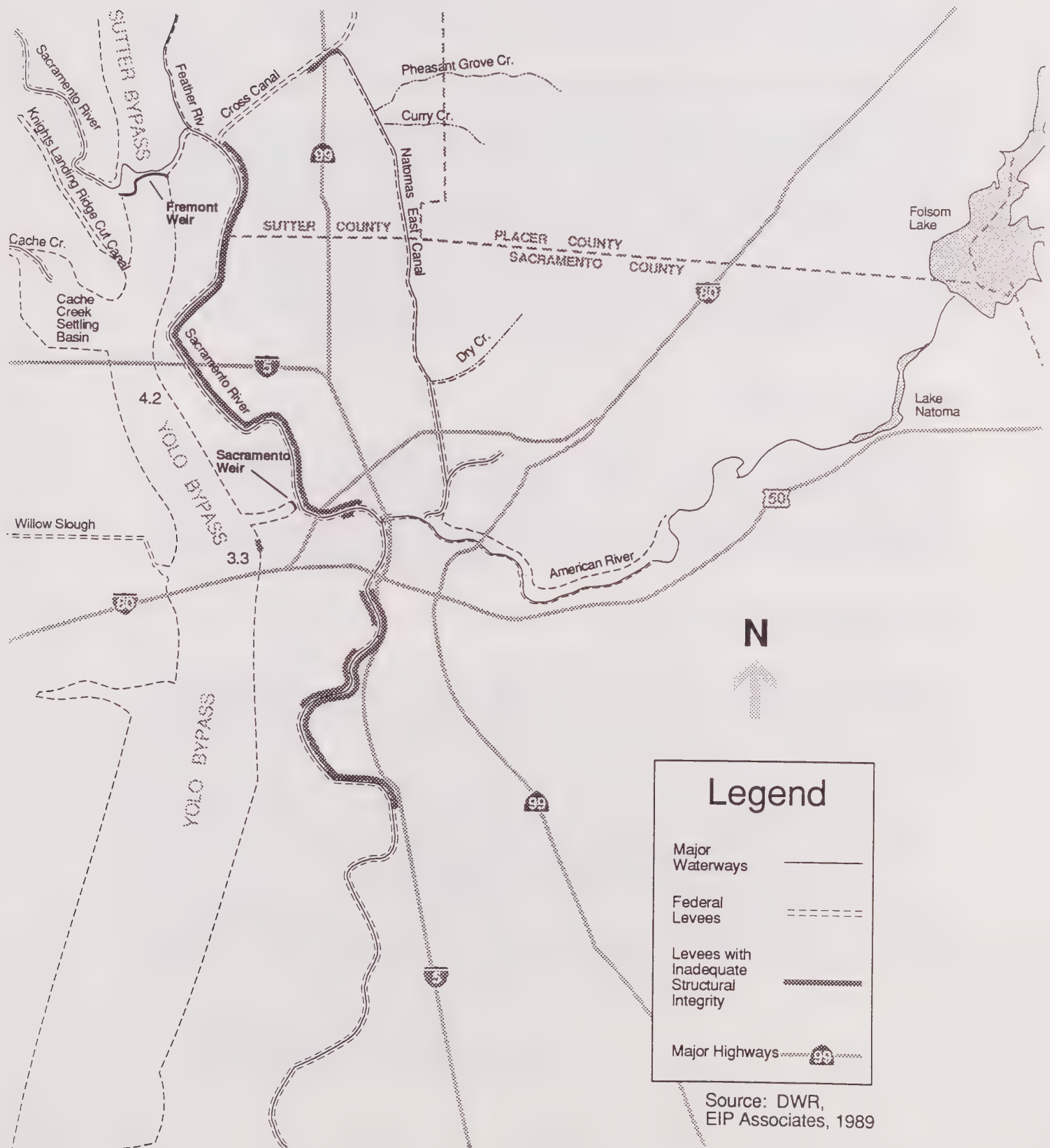
This study addresses the flood control system from Fremont Weir, north of Sacramento near Verona to Freeport south of Sacramento. A reconnaissance report has been completed and more detailed feasibility studies are under way. The State Reclamation Board and Reclamation District 900 are cooperating in this study. The study includes a wide range of alternative measures including:

- Modifying the Fremont Weir and the Yolo Bypass
- Modifying the Sacramento Weir and Bypass
- Diverting floodwaters into the Sacramento River
- Modifying the levee around West Sacramento
- Removing flow constrictions from the Yolo Bypass

Completion of these studies is dependent on agreements being formulated by those sharing in the local cost and considered as the cooperating partners.

Structurally Deficient Levees

Figure 8



American River Watershed Investigation

A comprehensive study of alternatives that would reduce the flood risk from the American River is being conducted by the USCOE. The alternatives being considered include:

- A flood control only or "dry" dam on the North Fork American River below its confluence with the Middle Fork.
- An expandable dam that initially would be constructed as a flood control dam but could be expanded at a later date to a larger multipurpose facility.
- A minimum pool dam that would serve primarily as a flood control facility but would include additional storage to provide for local water supply needs in the Placer and El Dorado County areas near the reservoir.
- Possible structural modifications to Folsom Dam that would provide additional flood control storage.
- The potential enlargement of the American River levees to provide additional flood protection as an alternative to the upstream dam options.
- Flood protection alternatives for the 53,000-acre Natomas area. These alternatives include the levee enlargement, floodgate structures, pump stations, and the modification of the Fremont Weir.

A draft feasibility report is scheduled for completion in April 1990 and a final report in October 1990.

Dry Creek Studies

Dry Creek studies are being performed by the USCOE to define measures to alleviate flooding in the Roseville area. The USCOE has conducted studies of the Dry Creek flooding problems in Rio Linda and Elverta. The studies being performed for the Natomas area also could result in measures that would partially mitigate the flood problems in the Rio Linda and Elverta area.

Morrison Creek Stream Group Studies

Morrison Creek Stream Group studies are continuing to be performed by the USCOE for the City of Sacramento. The purpose of the studies is to determine what level of protection is provided by the existing system and what improvements are necessary to increase the level of protection.

Auburn Dam

Auburn Dam, a large multipurpose dam at Auburn, continues to be under consideration by the U.S. Bureau of Reclamation and the California Department of Water Resources. The American River Authority, composed of the local Placer and El Dorado County government entities, is investigating local financing mechanisms for this project.

Repair of damages to levees and channels that occurred during the 1986 flood event

Extensive repairs to flood damaged facilities were completed following the 1986 flood. These included the repair of eroded channels and levees, the repair on levees damaged by sloughing or seepage, the installation of flood control gates at various locations, and the repair of flood damaged streets, roads, and structures. All levels of government have participated in this effort. The agencies involved include the USCOE, Federal Emergency Management Agency, California Department of Water Resources, State Reclamation Board, California Department of Transportation, County of Sacramento, City of Sacramento, and various reclamation districts and other local entities.

Temporary adjustment of the operation of Folsom Dam

The City of Sacramento is continuing to negotiate with the U.S. Bureau of Reclamation to provide additional flood control storage in Folsom Reservoir. The negotiations are currently on hold until the reoperation study of Folsom is completed in the spring of 1990.

Preparation of flood inundation and threat studies and emergency plans

The City of Sacramento has prepared inundation studies for Natomas and the Pocket area that define time and depth of flooding relationships in areas considered to be significantly at risk of flooding (see Appendix H). These studies have included the definition of emergency warning and responses procedures. The plans include an alert system that gives various levels of warning which are triggered by the amount of freeboard remaining on the levee. Critical facilities, such as schools and residential or day care centers, which may require special assistance in an imminent or actual flooding situation, have also been identified. Further time inundation studies are planned to be completed for other flood hazard areas within the City of Sacramento in the future.

Development of an evacuation plan to be implemented in the event of a major flood

Both the City and County of Sacramento have multihazard emergency plans that cover emergency procedures in the event of a flood event. The City of Sacramento Public Works Department also has an emergency plan that covers river flood events as well.

Legislative action authorizing continued limited construction activity in the designated flood plain areas

Special Legislation contained in the McKinney Homeless Assistance Act of 1988 prohibits the Federal Emergency Management Agency from imposing new flood insurance rates and design and land use restrictions for up to four years, as necessary. This legislation was prompted by recently defined 100-year flood plain limits and elevations. One of the main purposes of the Special Legislation is to give Sacramento time to mount an effective flood control effort (see Chapter 1 for a more detailed discussion).

Establishing the Sacramento Metropolitan Flood Protection Task Force to oversee and coordinate Sacramento efforts to achieve effective flood protection

The joint City-County Task Force is developing policies and overseeing the efforts to achieve effective flood protection. The Task Force has developed a Land Use Planning Policy within the 100-year flood plain to ensure that any development with the flood plain is consistent with the intent of the Special Legislation. The City of Sacramento is requiring that all new home purchasers be notified of any potential flood risk and that, at the time of issuance of a building permit, property owners sign an agreement with the City assuming the risk of flooding, waiving any flood-related property damage claims against the City and indemnifying the City against any such claims. Notice of the flood danger must be given to any future property owners.

Construction of flood control gates

As part of the flood control effort, flood control gates were constructed for various locations throughout the Sacramento area. Flood gates are placed in strategic locations to impede the progress of flood flows during a flood event.

Future Projects

As discussed, planning by various agencies is continuing to define flood protection measures for the Sacramento area. The major projects that have been defined are listed below in accordance with their apparent priority as determined by past and ongoing studies.

- ❏ Upgrading of 32 miles of Sacramento River levee to ensure structural integrity and to correct latent construction defects.
- ❏ Flood control facilities for the American River either by the construction of an upstream flood control dam, operational, or structural modifications of Folsom Dam and Reservoir, American River levee modifications, or some combination of these elements.

- ✧ Local flood control projects including levee and channel modification for Dry Creek and its tributaries, and the Morrison Creek Stream Group.
- ✧ Various potential projects depending on the results of ongoing feasibility studies including:
 - Fremont Weir and Yolo Bypass modification.
 - Sacramento Weir and Bypass modifications.
 - Levee improvements for the Natomas East and Canal, Natomas Cross.
 - Gated flood control structures and pump stations associated with levee and channel improvements in various areas including Natomas and the Beach-Stone Lakes area south of Sacramento.

It is possible that this will result in flood protection for storm events greater than the 1 percent or 100-year event that is required by FEMA standards. The USCOE is investigating projects that will provide protection from events that occur on the average of once in 200 years. Both the City and County are on record as supporting projects which provide at least a 200-year level of protection. Most recently the State Department of Water Resources (DWR) has announced that it will participate only in a project that provides a 200-year level of protection.

4.4 HAZARDS ASSOCIATED WITH THE 100-YEAR FLOOD

Calculating the 100-Year Event

Federal Emergency Management Agency requirements regarding flood insurance land use restrictions, and flood protective design requirements are based on a "100-year flood." The 100-year event is calculated by an integrated series of hydrologic and hydraulic calculations.

The 100-year flood is represented by the water surface elevation that is determined from the 100-year flow in the stream being studied. There is a 1 percent chance in any given year that a 100-year flood event will occur.

A hydrologic goal analysis must be conducted to determine the 100-year conditions for a given system. This analysis would consider the following factors:

- ✧ Area and shape of the watershed areas that contribute runoff to the stream.
- ✧ Slope and length of the tributary watershed area. Steeper area results in more rapid and larger runoff.
- ✧ Roughness of or resistance to flow of the watershed area. On a densely vegetated area the runoff will be slowed and reduced.
- ✧ Permeability of the soils in the area. More permeable soils will result in more infiltration or "loss" of precipitation during a storm thereby resulting in reduced runoff.
- ✧ Land use and ground cover in an area. Urbanized areas contain larger impervious areas such as roads, parking area, and rooftops resulting in lower losses and greater runoff. Densely vegetated and cultivated areas will have larger losses and lower runoff than fallow or sparsely vegetated areas.
- ✧ Sizes, lengths, slopes, and roughness of the channels or conduits in the watershed area that convey the flows to the stream. A densely vegetated stream with a winding or sluggish alignment will significantly attenuate or dampen the peak flows as compared to a man-made channel or storm drain.
- ✧ Storage reservoirs or ponds in the watershed. Generally, the storage will result in reduced flows, however, in some instances, their presence could result in increased flows at some points in a system. This potential increase in peak can result from a situation where runoff

from an area in the lower or downstream portion of watershed is temporarily stored or defined so that it combined more critically with flows from the upper reaches of a watershed.

- ✧ Precipitation in the watershed area. With large watershed areas, precipitation can vary widely. Therefore, it is important to break the watershed down into subareas so that a realistic average precipitation can be applied to an area. The distribution or timing of the precipitation is equally important as the total precipitation during a storm. Most flood-producing storms are characterized by very intense periods of rainfall that have been preceded by an extended period of less intense precipitation.

The hydrologic analysis uses both recorded streamflow and precipitation data. The computer model used to estimate runoff is "calibrated" by analyzing actual historic storms and adjusting the model to match the actual measured flows.

The flood water surface elevations are calculated using the flows determined from the hydrologic analysis and hydraulic calculations using a separate computer model. The factors considered in this analysis include:

- ✧ Size and shape of the channel section.
- ✧ Channel slope.
- ✧ Channel surface roughness.
- ✧ Flow construction, such as bridges or culverts.
- ✧ The water surface elevation at the downstream end or mouth of a stream being studied. For example, the flood surface elevation in the American River is affected by the water surface elevation of the Sacramento River. South of Sacramento, the Sacramento River water surface elevation can be affected by tidal elevations in the Delta.

Existing Level of Flood Protection and Associated Flooding Risk

The following is a discussion outlining types of levee failures and possible flooding scenarios that could occur with a 100-year flood event given the existing levels of flood protection along the Sacramento and American river systems.

Types of Levee Failure

Normally, a levee is considered to be inadequate and subject to failure when actual freeboard is less than the designed freeboard. Freeboard is the vertical distance from water surface to the top or crown of the levee. For the Sacramento River a minimum three-foot freeboard is required; for the American River a minimum five-foot freeboard is required. The freeboard is essentially a safety margin and when it is encroached upon, the levee is no longer considered safe. For example, the May 1989

Preliminary FIRM, as shown on Figure 1, page 26, is based on the assumption that levee failures occur at the most critical locations when the freeboard requirement is not met.

Levee failures result from one of four basic conditions, including overtopping, erosion, structural instability or sloughing, and seepage or piping.

Overtopping

Overtopping is probably the least common cause of failure since most levee failures have occurred before the water surface elevation reaches the levee crown. An overtopping failure is the most "predictable" and preventable since the rise in water levels can be monitored and sandbags or additional earth material can be added. An overtopping failure usually will result in a levee breach caused by erosion of the levee material as the water flows over the levee section at high velocities.

Erosion

An erosion failure is the result of eroding or washing away of the levee section due to high velocity flows or waves. A potential erosion failure can be prevented by placing erosion-resisting material, such as rock or concrete on the eroding surface. Generally, a levee will fail due to instability caused by the loss of the levee section before it completely erodes away. An erosion failure can occur rapidly once the process is started.

Structural Instability

A structural failure is generally the result of an unstable levee section. The strength of the levee section is reduced with high water levels since a larger percentage of the levee becomes saturated with water. The saturation reduces the friction or cohesion between soil particles. An instability or sloughing failure can be partial or complete. A partial failure, such as occurred on the Sacramento River along the Garden Highway during the 1986 flood, can be corrected by the placement of additional material to reinforce the levee section.

Seepage or Piping

A seepage, or "piping," failure is the result of water moving through the levee at a rate high enough to cause erosion of the levee material within the levee section. This results in the formation of a void, or "pipe," through the levee section that leads to the sudden collapse of the levee. This type of failure can result from the use of very fine grained silty or sandy materials for the levee construction, such as is the case for significant portions the Sacramento River levees. Tree roots and rodent holes in the levee section can also result in a flow path that may cause this type of failure. This failure can be prevented if the seepage is noted early enough to implement corrective measures such as the placing of sandbags on each dike around a point where a seepage "boil" is noted on the land side of the levee. A "boil" is the point

where the earth material and seepage water are escaping on the land side of the levee. The placement of the sandbags on the dike results in a small "pond" of water which reduces the "head" (difference in water levels between the stream and the land side), thereby reducing the seepage flow velocity. Permanent corrective measures for seepage include the construction of an impermeable "cutoff wall" in the levee section, or collection drains on the land side of the levee.

Levee failures can be rapid and catastrophic, such as occurred at Rio Linda and Olivehurst during the 1986 flood. When these failures occurred, the water levels in the Yuba River were well below the design freeboard. This levee apparently failed due to some unknown structural defect.

Possible Flooding Scenarios

The following are a series of possible flooding scenarios in Natomas, the Pocket Area, and the remaining flood plain area should a 100-year flood occur given existing flood control conditions.

Natomas

The Natomas area is currently believed to have approximately 40-year protection given the current flood control conditions along the Sacramento River, American River and the Natomas East Main Drainage Canal (NEMDC). The Natomas area potentially could be inundated by both the Sacramento and the American river systems by depths of 8 to 23 feet of water.

According to the City of Sacramento's Natomas Area Evacuation Plan, flooding in the Natomas area could occur as a result of levee overtopping or levee failure. Overtopping of the NEMDC caused by backwater flows from the American River and peak flows on Dry Creek and Arcade Creek, is likely to occur slowly, providing a warning time of up to several hours. However, a sudden levee break along the Sacramento or American river systems would result in extensive flooding with relatively little warning.

In the City of Sacramento's "Imminent/Actual Flooding Conditions (Levee Overtopping/Failure) Natomas Area" (See Appendix H), four locations were evaluated assuming a 500-foot levee break.

American River at the Garden Highway

Location 1 is along the American River at the Garden Highway, between River Plaza Drive and Truxel Road. Generally the flood flows will follow the Brannon Creek Slough and channel through low-lying streets in a northerly direction, to the lowest elevations within the basin. At this location, the streets at an elevation of 11.5 feet (20 percent of all streets) would be flooded to a depth of 1.5 to 2 feet in .4 hours; streets at an elevation of 13 feet (30 percent of all streets) would be flooded to a

depth of 1.5 to 3 feet in 1.2 hours; and streets at elevation 15 feet (40 percent of all streets) would be flooded and the flood flows would begin to overtop I-80 in 2 to 3 hours.

Natomas East Main Drainage Canal

Location 2 is the Natomas East Main Drainage Canal at Arcade Creek. Flood waters will channel westward through residential streets, such as Indiana Avenue, until reaching high ground at a north-south transmission line easement. Three outflows, San Juan Road, West El Camino Avenue and Edmonton Drive, cut through this easement. Ponding will occur east of the transmission line easement at the same time that ponding occurs in the lower areas of Southeast Natomas, as far west as the Frates Ranch Subdivision between Azevedo Drive and the I-5 sound wall. At this location streets at elevation 11.5 feet (20 percent of all streets) would be flooded to a depth of 1 to 2 feet in 2 hours; streets at elevation 13 feet (30 percent of all streets) would be flooded to a depth of 1.5 to 3 feet in 4.5 hours; and streets at elevation 15 feet (40 percent of all streets) would be flooded to be level with the freeway in 6 to 7 hours.

Sacramento River at Gateway Oaks Drive

Location 3 is along the Sacramento River at Gateway Oaks Drive. Flood water will travel through West Natomas and then north across to North Natomas. The West Natomas Basin is separated into five sub-basins. This flow path is tentative since it assumes that all earthen weirs and barriers are stable. This study also assumes that the NEMDC is full and unable to store any further runoff. Also, all sub-basins fill to approximately 15 feet, at varying depths, before crossing a weir into the next sub-basin. The final outflow over I-80 is at approximately 15 feet. It is therefore possible that due to unstable soils, the flow could skip the filling of intermediate basins and take a more direct (and quicker) route to the exit point, rather than flooding the entire basin. The scenario for Location 3 demonstrates the path to fill the entire basin in the shortest amount of time. The sub-basins will fill in .06 to .7 hours.

Sacramento River at Orchard Lane

Location 4 is along the Sacramento River at Orchard Lane. This breakout will fill sub-basins 3 and 4 to a depth of 2 to 3 feet before it continues to sub-basin 1 (see Appendix H). This break was assumed to take the more direct route to the outlet over I-80, due to momentum. Assuming a 15 foot elevation, sub-basins 3 and 4 will fill in .2 hours and will then inundate sub-basin 1 in .5 hours.

According to the USCOE's Reconnaissance Report on the American River Watershed Investigation, "On the basis of occurrences during the February 1986, there would probably be little warning time to evacuate Natomas. In addition, many of the major evacuation routes, such as Highway 99 north, Main Avenue of the NEMDC, and many roads leading into the Rio Linda and Del Paso areas, would probably be flooded prior to any levee failure. If a levee breach had occurred in 1986, it could have been sudden and unexpected, and flood waters could have quickly

covered many of the roads leading out of the area. Inability to use many of the roads during a flood emergency would make evacuation of the area extremely difficult and significant loss of life possible."

The Pocket Area

The Pocket Area is currently believed to have approximately 63-year flood protection given the current flood protection along the Sacramento and American river systems. Flooding in the Pocket Area can occur from levee failure along the Sacramento and/or the American River Systems. The following flooding scenarios could occur should there be an assumed 500-foot breach in the levee along the Sacramento River System in one of the locations identified in the City of Sacramento's "Time Inundation Study Pocket Area March 1989." (See Appendix H.)

Oak Hall Bend

Levee failure near Oak Hall Bend would result in a flood flow southward through Seymour Park to the area just south of Florin Road near the central portion of the area where the flow will collect and begin to fill the area. The northeast corner of the study area will be flooded immediately and access to the exits at Riverside and 43rd Avenue from most of the Pocket Area will be cut off by breach outflow. Within the first hour approximately 40 percent of the Pocket area will be flooded and the exits at Gloria Drive, 56th Avenue, Florin Road and South Land Park Drive will be inaccessible. Pocket Road, the only exit for the southern portion of the area, will be flooded within 2 hours, leaving only the levee maintenance road as an exit from the area. In 3 to 4 hours water will begin to flow over I-5 stopping traffic in both the northbound and southbound directions. In slightly less than 16 hours just under 95 percent of the Pocket Area will be flooded to an elevation of 14 feet, when water will begin to overtop Freeport Boulevard, and have a maximum depth of approximately 10 feet near the center of the area.

Garcia Bend

The levee near Garcia Bend was identified by the U.S. COE as having a low factor of safety because of structural instability problems and was recommended for immediate remedial repair. In the event of a failure of this levee, the flow path would be generally eastward, initially following the local streets, toward the central portion of the basin where it will spread out and eventually back up against I-5. In just under an hour, more than 35 percent of the area will be flooded and the water will have spread north and south along I-5 cutting off access to the exits at 56th Avenue, Florin Road, and South Land Park Drive. The exit at Pocket Road will be cut off within 2 hours and in approximately 3 to 4 hours water will begin to flow over I-5 interrupting traffic in both the northbound and southbound directions. After 7 to 8 hours, nearly 75 percent of the basin will be covered with water and the 43rd Avenue exit will be partially or completely flooded. In 15 to 16 hours the flood level will reach an elevation of 14 feet and flow will begin over Freeport Boulevard. At this point between 90 percent to 95 percent of the basin will be inundated.

Southwest Corner of the East Levee

A levee failure along the southwest corner of the east levee along the Pocket Area will initially flood the small, low-lying area around River Lake before overflowing into the central portion of the basin. The access to the exits at 56th Avenue, Florin Road, and South Land Park Drive will be blocked and the area between the breach and I-5 will be separated from the rest of the Pocket area. Within 1 to 2 hours the access to the exit at Pocket Road will be flooded and the southeast area will be nearly enclosed. The levee maintenance road will provide an exit but access to the top of the levee in this area is limited. By the end of 7 or 8 hours the basin will be flooded to an elevation of 10 feet and between 70 percent to 75 percent of the basin will be covered by water. Access to the exit at Riverside Boulevard will be impaired or completely blocked leaving only the levee road to provide an exit from the area. In just over 15 hours approximately 95 percent of the basin will be inundated to an elevation of 14 feet and water will begin flowing over Freeport Boulevard.

The Remaining Flood Plain Area

In general, the levee systems along the Sacramento and American rivers are believed to have approximately 63-year protection unless otherwise stated. There are numerous flooding scenarios which could impact the areas in the flood plain. Some of these will be described using information collected from the USCOE (Sibilsky and Yarwood, 1989).

Sacramento River East Levee

The reach of the Sacramento River east levee between the town of Freeport upstream to Miller Park is considered unstable during a 100-year flood event. Two basic scenarios of flooding caused by levee failure due to instability were considered, one north of Sutterville Road and one south. Flood waters starting north of Sutterville Road would inundate parts of "Downtown Sacramento" and the William Land Park area. Flood waters would pond along the north side of the levee north of the Sacramento Executive Airport. The levee would fail due to overtopping and flood waters would then spread south inundating the Executive Airport and Meadow View/Pocket areas. Eventually, the flood waters would overtop the Morrison Creek levee system near the Sacramento River and I-5.

Flood waters starting south of Sutterville Road would spread east to the Union Pacific Railroad tracks and south to the Morrison Creek levee system. The flood waters would pond against the northern side of the Morrison Creek levee reach between the Sacramento River and I-5 and then overtop the levee and continue southerly into the Beach-Stone Lakes Basin.

American River North Levee

The reach of the American River north levee from the California Exposition grounds upstream to the Arden Sewage Treatment Plant has insufficient freeboard. Flooding beginning upstream of Watt Avenue would be restricted at the Watt Avenue/American River Drive undercrossing. This flooding would continue westerly along the north side of the river levee into the Campus Commons area. High ground near Arden Fair in conjunction with the earthen barrier around the California Exposition race track can cause flood waters to pond and force them to overtop the river levee and flow back into the river. However, failure of the race track embankment from freeboard encroachment would cause severe flooding of the California Exposition/Arden Fair and North Sacramento areas. Floodflow would be restricted at the Southern Pacific Railroad/State Highway 160 undercrossing but would ultimately overtop the railroad tracks between State Highway 160 and Arden Way. The flood waters would pond against the levee systems of the Natomas East Main Drainage Canal, Arcade Creek, and the American River north levee at the Union Pacific Railroad crossing.

American River South Levee

The south side of the levee of the American River could fail due to levee encroachment causing outfalls from just upstream of Watt Avenue to the vicinity of the Guy West pedestrian bridge at the California State University, Sacramento campus. The flood waters would flow westerly between the river and the northern embankments of the Southern Pacific Railroad (SPRR) Folsom Line and State Highway 16 and pond against the secondary levee of the SPRR. It is possible under a worst-case scenario for the floodflows to split at this point and part of them to spread southwesterly and part northwesterly. The southwesterly flow would begin by encroaching and causing failure of the SPRR Folsom Line levee. The flood waters would flow along the eastern side of the main line levee to around 14th Avenue, overtop the SPRR levee and flow into the southern part of the City of Sacramento. Shallow floodflows would continue westerly north of Morrison Creek to the Union Pacific Railroad (UPRR) tracks. The floodflows would then spread southerly to the junction of Morrison Creek and the east embankment of the UPRR.

The northwesterly split would flow between the southern levee of the river and the secondary levee of the SPRR main line to the vicinity of Business 80. The flood waters would encroach, subsequently failing the SPRR embankment and overtopping the flood gate embankments for Business 80, and spread southwesterly. The flows would inundate parts of the Downtown Sacramento, East Sacramento, and William Land Park areas. The flood waters would pond against the levee on the north side of the Sacramento Executive Airport and Meadowview/Pocket areas. Eventually, the floodflows would pond behind the Morrison Creek levee system. However, overflow from the Sacramento River would flood Downtown Sacramento and areas to the south to a greater extent.

Instability of the southside of the American River levee section upstream and downstream of the 16th Street Bridge could cause flooding in the northeast part of the Downtown portion of the city, west of the city sanitary landfill, south of the river,

and north of the SPRR tracks. Flooding will not continue south of the SPRR tracks because of the elevated rail system and flood gates.

Natomas East Main Drainage Canal

Flows routed through the NEMDC would be affected by the loss of storage due to the backwater effects from the American River, and by the timing of incoming flows, particularly from Arcade Creek where the peak flow occurs before the peak flows on Dry Creek. Levee failures from freeboard encroachment were evaluated for several reaches along both the east and west embankments of the NEMDC. The failed reaches that were determined by initial evaluation to cause the greatest inundation were then studied further to ascertain the full extent of flooding in overbank areas. The results of these analyses indicated the following: Flooding in the Robla/Del Paso Heights area north of Arcade Creek and in the North Sacramento region south of Arcade Creek would result from failures along the canal east levee. However, inundation of the North Sacramento region would be due principally to American River flood waters. Failures along the NEMDC west levee would cause flooding in Natomas, however, overflow from the Sacramento River would flood the district to a greater extent.

Analysis of flows in Arcade Creek indicate that failure due to insufficient freeboard of the north levee along the creek will cause flooding, however, overflow from the NEMDC would flood the lower-reach area north of the creek to a greater extent.

Analysis of the flows in Dry Creek indicate that flooding will be contained (except the lower 500 feet) within its levee system contributing to the subsequent failure of the NEMDC levees.

5. ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

5.1 INTRODUCTION TO THE ANALYSIS

Scope of the EIR

This EIR is being prepared as a "Program EIR" pursuant to Section 15168 of the CEQA Guidelines. On July 18, 1989, the City of Sacramento Planning and Development Department issued a Notice of Preparation (NOP) for the EIR. The NOP identified the following issues to be evaluated in the EIR:

- ☒ Land Use
- ☒ Plan and Policy Consistency
- ☒ Public Health and Safety
- ☒ Cumulative Impacts
- ☒ Growth Inducement

Issues Not Included in the EIR

Based on the City's evaluation, it was determined that it was not necessary to evaluate the following issues in the EIR:

- ☒ Soils and Geology
- ☒ Air Quality
- ☒ Water Resources
- ☒ Plant Life
- ☒ Animal Life
- ☒ Noise
- ☒ Light and Glare
- ☒ Natural Resources
- ☒ Risk of Exposure to Hazardous Substances
- ☒ Population
- ☒ Housing
- ☒ Transportation/Circulation
- ☒ Public Services
- ☒ Energy
- ☒ Utilities
- ☒ Aesthetics
- ☒ Recreation
- ☒ Cultural Resources

The determination that the Proposed Land Use Policy would not have significant impacts on the above listed topical areas was based primarily on the definition of the project as a policy which would allow development in areas exposed to greater than 1 percent chance of flooding in any given year. The level of development described in this EIR is essentially the same as that evaluated in the City of Sacramento General Plan EIR and other recent EIRs in the City. This EIR is intended to serve as a "Program EIR" addressing the risk of flooding to which people or property will be

exposed in connection with each project subsequently undertaken in the City or the County. Accordingly, this EIR is designed to supplement the project-specific environmental documentation which may be required for each such future project. In those environmental documents, project-specific analyses related to the issues listed above will be included for determination as to significance of impacts.

Evaluation of Alternatives in the EIR

As required by Section 15126(d) of the CEQA Guidelines, this EIR evaluates the comparative impacts of "a range of alternatives to the project" (see Chapter 7). The alternatives are designed to eliminate or mitigate to a less-than-significant level all significant effects of the Proposed Land Use Policy, and to provide adequate information to allow an informed choice by the decision makers. As is allowed under CEQA, the impacts of the alternatives are evaluated "in less detail than the discussion of significant impacts of the proposal." Mitigation measures which may be required to eliminate or lessen impacts of the alternatives are also presented.

The CEQA Guidelines require the analysis of alternatives which could eliminate significant impacts "even if these alternatives would impede to some degree the attainment of project objectives". In order to provide full information, a description of the relationship of the alternative to the objectives of the Proposed Land Use Policy is included in the discussion of each specific alternative.

Analysis of Risks Associated with Flooding

This EIR focuses on an analysis of the relative risks to life and property associated with exposing new development to flooding by a 100-year flood. A 100-year flood event is defined as a flood which has a 1 percent chance of occurrence in any given year. The actual size of the flood is determined by FEMA in conjunction with the USCOE. Protection from the 100-year flood does not entirely eliminate the risk of flooding or flood damage in Sacramento. There is always a chance that a flood event of greater magnitude than the 100-year flood could occur. For example, there exists a 0.5 percent chance of exposure to the 200-year flood and, similarly, a 0.2 percent chance of exposure to the 500-year flood. Thus, provision of 100-year flood protection does not eliminate flood risk; it simply decreases the risk to a statistical probability of less than 1 percent each year.

By adopting the 100-year flood as the base flood for purposes of its implementation of the National Flood Insurance Program (NFIP), FEMA has indicated that less than 1 percent chance of flooding is an acceptable risk, whereas exposure to greater than a 1 percent chance of flooding is an unacceptable risk. It is, therefore, appropriate that this EIR use exposure to the 100-year flood as a threshold of significance for the evaluation of environmental effects. For the purposes of this analysis only, exposure to flooding greater than 1 percent per year is considered a significant impact.

Recent policy direction from representatives and policy makers of the City of Sacramento and County of Sacramento indicates that 200-year flood protection is desirable. This policy direction is acknowledged, but is independent of this study which evaluates a policy directly related to FEMA regulations and FEMA standards

as discussed above. It should be noted, however, that provision of 200-year flood protection would not completely eliminate flood risk; it would decrease the chance of exposure to flooding from 1 percent per year to 0.5 percent per year. Some risk of flooding would continue to be present.

Presentation of the Impact Analysis

The evaluation of impacts and identification of mitigation measures included in this EIR is an integrated assessment of potential effects of the Proposed Land Use Policy and potential solutions which could reduce the degree of severity of those effects. For each significant impact that is described, a measure which could serve to eliminate or decrease the severity of the impact is identified.

5.2 CONSISTENCY WITH PLANS, POLICIES, AND PROGRAMS

SETTING

Introduction

Land uses in the flood plain are regulated under local and Federal law, by the Federal Emergency Management Agency (FEMA) through the National Flood Insurance Program and related regulations. The City and County regulate land use through their general plans and land use regulations, and have complied with FEMA regulations by adopting flood plain management ordinances in order to maintain their eligibility for flood insurance.

City of Sacramento Plans and Regulations

City of Sacramento General Plan

The City General Plan was last updated in 1988. The USCOE study showing the extent of the areas possibly subject to flooding in the event of a 100-year storm was not complete at that time, but the General Plan recognizes the studies then and now in progress in the aftermath of the 1986 floods.

The City General Plan has the following goals and policies in regard to flood protection.

FLOOD HAZARDS

Goal A

Protect against flood-related hazards wherever feasible.

Policy 1

Prohibit development of areas subject to unreasonable risk of flooding unless measures can be implemented to eliminate or reduce the risk of flooding.

OPEN SPACE FOR PUBLIC HEALTH AND SAFETY

Goal A

Continue to work toward providing a levee system which protects the community from flood-related hazards and makes use of its open space areas where appropriate.

Policy 1

Support levee reconstructions with appropriate crown width for recreational use to the extent feasible.

Levee crowns offer potential for compatible and varied recreational uses. There are a number of levee crowns along the Sacramento River levee system than could offer more recreational benefits when they are improved.

City of Sacramento Flood Control Regulations

The City of Sacramento regulates development in flood hazard areas under City ordinances 88-001 and 88-002. The requirements of these ordinances reflect Federal regulations for construction within designated flood hazard areas. These regulations apply to all areas of flood hazard. The following definitions are relevant to this discussion.

"Floodway" means the channel of a river or other watercourse and the adjacent land areas that must be reserved in order to discharge the base flood without cumulatively increasing the water surface elevation more than 1 foot. Also referred to as "Regulatory floodway."

"Special flood hazard area (SFHA)" means an area having special flood or flood-related erosion hazards, and shown on a Flood Hazard Boundary Map (FHBM) or FIRM as those areas subject to inundation by a flood having a one percent or greater chance of being equaled or exceeded each year.

"Floodproofing" means any combination of structural and nonstructural additions, changes, or adjustments to structures which reduce or eliminate flood damage to real estate or improved real property, water, and sanitary facilities, structures, and their contents.

In floodways, the regulations prohibit development of any kind unless it can be certified that development or other encroachments will not result in an increase in flood levels during the occurrence of the base flood discharge. In other flood hazard areas, (the flood plain), construction requirements include elevating the first floor of the structure one foot above the level of the 100-year flood for residential development. For non-residential development, lower levels of structures may be below the elevation of the base flood but must be floodproofed.

County of Sacramento Plans and Regulations

County of Sacramento General Plan

The County is now in the process of updating the County General Plan. The current General Plan was adopted in 1982 and has been amended a number of times since then. County General Plan policies related to flooding are reprinted below. County General Plan policies are generally aimed at solving flooding problems in areas of existing development, and in preventing new development in areas of flood hazard, especially development that would contribute to increased flooding problems.

2.4 Flood Control, Storm Drainage, and Water Resources

- 2.4.1 Encourage a consolidated approach to the management of water resources and flood protection.
- 2.4.2 Continue the coordination effort with local, state, and federal agencies to achieve adequate water quality and flood protection.
- 2.4.3 Provide for sound management and protection of groundwater and surface water resources, and their quality.
- 2.4.4 Promote more diligent and efficient use of water resources and discourage wasteful practices.
- 2.4.5 Continue to implement flood plain policies and other actions required pursuant to the Cobey-Alquist Act, and maintain the County's qualification under the Federal Flood Insurance Act.
- 2.4.6 Preserve or enhance the aesthetic qualities of natural drainage courses in their natural or improved state compatible with flood control requirements and economic, environmental, and ecological factors.
- 2.4.7 Solve the problems of flood control in areas where an existing development has encroached into a flood plain, including actions such as:
 - A. Improving the drainage channel and installing lining, and fencing, as appropriate, only when other solutions are not feasible.
 - B. Securing flood or flowage easements and holding harmless agreements, and reflect the potential flood hazard in the assessed valuation of the properties subject to flooding.
 - C. Floodproofing structures within the flood plain where it is desired to preserve extensive reaches of open area without improvements to the existing channel.
 - D. Purchasing properties for public use where it is highly desirable to maintain the channel in its natural state and where existing structures would be inundated.
- 2.4.8 Direct development activities away from the 100-year flood plain of designated Natural Streams consistent with guidelines adopted in the Natural Streams Plan in order to minimize health and safety hazards, property loss, and environmental disruption and foster stream enhancement, improved water quality, and recreational opportunities.
- 2.4.9 Prevent the construction of large contiguous paved areas in development proposals reviewed by the County unless adequate mitigation measures to reduce runoff are provided.

- 2.4.10 Encourage the dispersal of storm and domestic runoff on the development site, rather than directing it into drainage courses, and minimize the contribution that development would add to the flooding of downstream parcels.
- 2.4.11 Discourage urban uses in aquifer recharge areas.
- 2.4.12 Protect the groundwater supply and the aquifer from contamination by percolation of effluent or direct drainage of effluent into the groundwater table.
- 2.4.13 Require the establishment of public maintenance entities for both septic tank maintenance purposes and public water supply districts as condition for approval of tentative subdivision maps in Agricultural-Residential areas.
- 2.4.14 Give full consideration to environmental and economic impacts of all flood control projects and drainage projects.
- 2.4.15 Develop and improve systems and facilities capable of accommodating projected population growth while assuring the protection, conservation, and maintenance of high quality ground and surface waters, and adequate reserves and supplies for the future.
- 2.4.16 Fully consider in all water supply development projects, the impact on fish, wildlife, vegetation, and other elements of the environment and ecology, and provide for their protection.
- 2.4.17 Regulate, through zoning and other ordinances, land use and development in all areas subject to potential flooding and prohibit urban-type uses on unprotected flood land.
- 2.4.18 When possible, acquire land for parks and public access in portions of the flood plains for aesthetic and other recreational enjoyment.
- 2.4.19 Encourage good soil conservation practices in agricultural and urban areas and carefully examine the impact of proposed urban developments with regard to drainage courses.
- 2.4.20 Recognize the changing and fragile nature of the Delta levee system in regulating land uses for that area.
- 2.6.6 Coordinate with the Delta Advisory Planning Council, other Delta counties, the State Department of Water Resources, the U.S. Army Corps of Engineers, local reclamation and levee maintenance districts and the Delta Citizens Municipal Advisory Council in solving the Delta levee problems.

County of Sacramento Flood Control Regulations

The County designates flood hazard areas with the "F" flood combining land use zone. County regulations, like the City regulations, are based on the Federal Flood Plain Management regulations, and the requirements are basically the same as the City's, although there is not a separate ordinance for subdivisions. An additional requirement of the County F zone is that if neither a public water supply nor a public sewerage facility is in use, the net lot area for each lot or parcel shall be not less than one acre.

Regional Plans and Regulations

Sacramento Metropolitan Flood Protection Task Force

The Sacramento Metropolitan Flood Protection Task Force is a regional body that has been working toward a regional policy and possible solutions for flood issues raised by recent studies. The Task Force was formed in response to the need for regional flood protection and includes members from Sacramento County, the City of Sacramento, Reclamation District 1000, the American River Flood Control District, and Sutter County. The Task Force has two charges; to develop consensus on the flood control project to be undertaken, and to form a funding entity to pay for the flood control project. It is expected that a Joint Powers Agreement (JPA) will be undertaken by the jurisdictions involved in the Task Force, and that the authority created by the JPA will be responsible for regional flood protection.

SACOG

The Sacramento Area Council of Governments (SACOG) is primarily concerned with transportation planning. It does not do land use planning, and has not formulated any policies related to flood plain management.

Regional Regulations

There are no regional regulations concerning land use and development in areas subject to flooding. Some regional agencies, such as the American River Flood Control District and Reclamation District 1000, have special area jurisdiction over flood control facilities, but do not regulate land use or development. These agencies are part of the Task Force and participate in flood planning. Figure 9 shows City of Sacramento boundaries.

City of Sacramento Boundaries

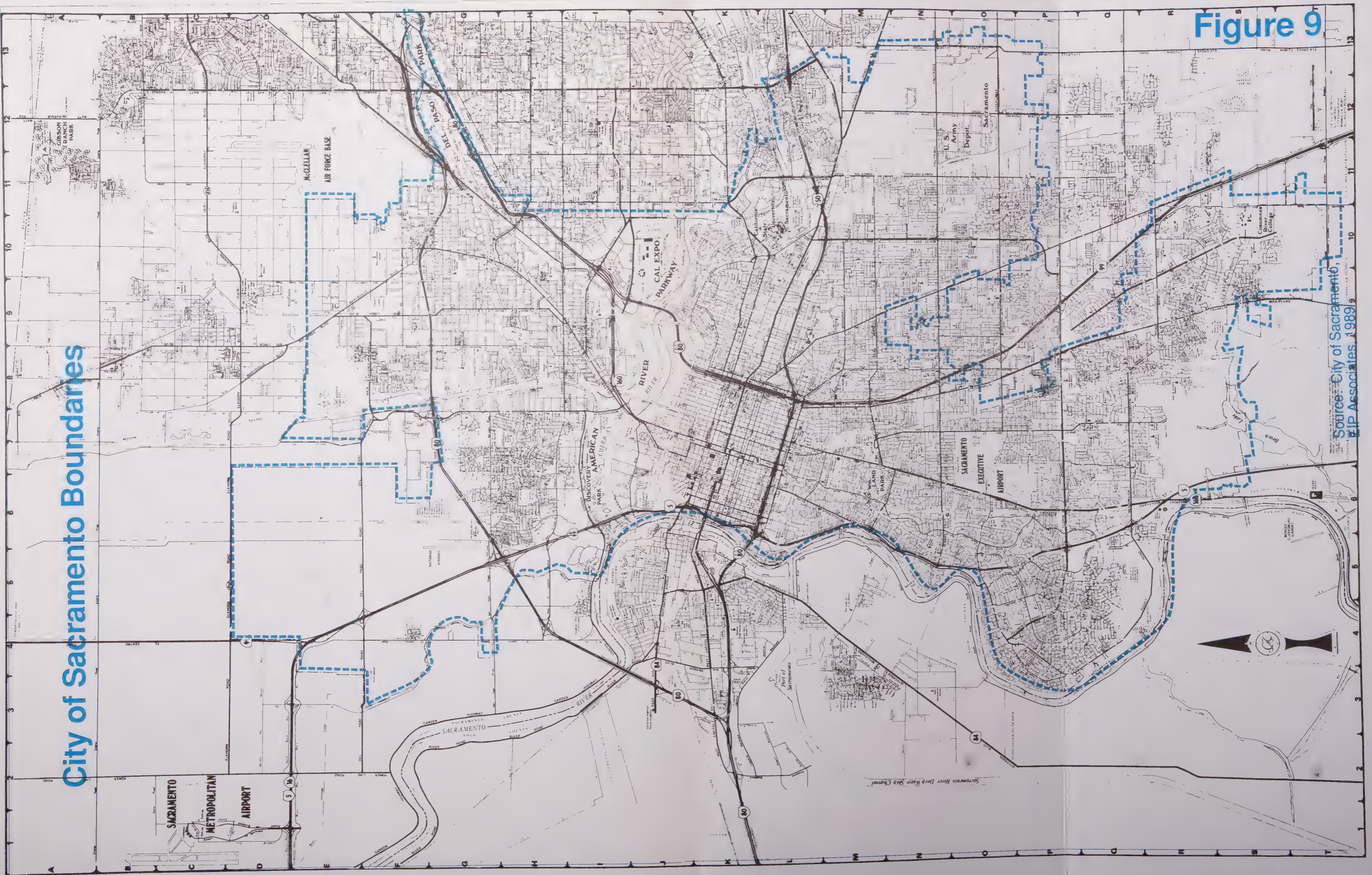


Figure 9

Source: City of Sacramento, 1989.
 PIP Associates, 1989.

State Flood Plain Management

Department of Water Resources

The State Department of Water Resources (DWR) is the state coordinating agency that works with FEMA, and, under Executive Order B3977, is the state coordinator for flood plain management. DWR advocates a non-structural approach to flood control, based on land use planning. DWR implements the State Water Code, and works with the State Office of Planning and Research in formulating those sections of the State General Plan Guidelines relating to flood plain management (Lee, 8/11/89).

Department of Fish and Game

The Department of Fish and Game (DFG) has jurisdiction pursuant to Fish and Game Code Section 1600 et seq., over any work in areas of riparian nature or within the historic bed of a waterway. Within these types of areas, a Streambed Alteration Agreement with the DFG is required. The 100-year flood plain includes areas under DFG jurisdiction, and areas such as Natomas which are largely outside that jurisdiction.

Federal Plans and Regulations

National Flood Insurance Program

The Federal Emergency Management Agency (FEMA) administers the National Flood Insurance Program, which provides for flood insurance nationwide. FEMA determines areas subject to flood hazards and designates these areas by relative risk of flooding on a map for each community, known as the Flood Insurance Rate Map (FIRM). The FIRM indicates the risk premium rate zones applicable in the community and when those rates are effective. The symbols used to designate those zones are as follows:

| <u>Zone symbol</u> | <u>Definition</u> |
|--------------------|---|
| A | Area of special flood hazard without water surface elevations determined. |
| A1-30, AE | Area of special flood hazard with water surface elevations determined. |
| AO | Area of special flood hazards having shallow water depths and/or unpredictable flow paths between one and three feet. |

| | |
|-----------|--|
| A99 | Area of special flood hazard where enough progress has been made on a protective system, such as dikes, dams, and levees, to consider it complete for insurance rating purposes. |
| AH | Areas of special flood hazards having shallow water depths and/or unpredictable flow paths between one and three feet, and with water surface elevations determined. |
| V | Area of special flood hazards without water surface elevations determined and with velocity, that is inundated by tidal floods (coastal high hazard area). |
| V1-30, VE | Area of special flood hazards, with water surface elevations determined and with velocity, that is inundated by tidal floods (coastal high hazard area). |
| VO | Area of special flood hazards having shallow water depths and/or unpredictable flow paths between one and three feet and with velocity. |
| B, X | Area of moderate flood hazards. |
| C, X | Area of minimal hazards. |
| D | Area of undetermined but possible flood hazards. |
| M | Area of special mudslide (i.e., mudflow) hazards. |
| N | Area of moderate mudslide (i.e., mudflow) hazards. |
| P | Area of undetermined but possible mudslide hazards. |
| E | Area of special flood-related erosion hazards. |

The National Flood Insurance Act of 1968 was enacted by Title XIII of the Housing and Urban Development Act of 1968 to provide previously unavailable flood insurance protection to property owners in flood-prone areas. The Flood Disaster Protection Act of 1973 requires the purchase of flood insurance on and after March 2, 1974, as a condition of receiving any form of Federal or Federal-related financial assistance for acquisition or construction purposes with respect to insurable buildings and mobile homes within an identified special flood, mudslide (i.e., mudflow), or flood-related erosion hazard area that is located within any community participating in the program.

FEMA programs relate to three areas: lending, insurance rates, and regulations concerning development. The designation of a flood hazard zone determines the rate property owners will pay for flood insurance in that zone and requires such insurance for any type of structure built with federally backed financing or financing

by a federally regulated lending institution. In addition, the National Flood Insurance Program regulations impose certain construction requirements or other means of flood protection for development located within certain flood hazard zones.

Flood Insurance Rate Map (FIRM) Zones

The FIRM prepared by FEMA for a community designates areas within the 100-year flood plain as Zone A. An AE Flood Hazard zone designation means that FEMA has determined the elevation of the base flood (the 100-year flood), which is used to determine how high a structure must be elevated and/or floodproofed to be protected from the 100-year flood.

The A99 Flood Hazard zone designation was created for use in areas where federally funded projects to provide 100-year flood protection were close to completion. The A99 Flood Hazard zone is defined above.

By definition, the A99 Flood Hazard zone does not designate flood elevations, and the designation anticipates that the area will not be subject to the 100-year flood after a short period of time. According to FEMA, there are effectively no FEMA regulations restricting development in the A99 Flood Hazard zone (Eldridge, 1989). However, such development is subject to certain construction design regulations and flood insurance is required for any development including federally backed financing.

Requirements for Construction in A99 Flood Hazard Zones

Sections 60.3(a) 1 through 4 and 60.3(b) 5 through 8 regulate construction in A99 Flood Hazard Zones.

Sec. 60.3(a)

(1) Require permits for all proposed construction or other development in the community, including the placement of manufactured homes, so that it may determine whether such construction or other development is proposed within flood plain areas;

(2) Review proposed development to assure that all necessary permits have been received from those governmental agencies from which approval is required by Federal or State law, including Section 404 of the Federal Water Pollution Control Act Amendments of 1972, 33 U.S.C. 1334;

(3) Review all permit applications to determine whether proposed building sites will be reasonably safe from flooding. If a proposed building site is in a flood-prone area, all new construction and substantial improvements shall (i) be designed (or modified) and adequately anchored to prevent flotation, collapse, or lateral movement of the structure resulting from hydrodynamic and hydrostatic loads, including the effects of buoyancy, (ii) be constructed with materials resistant to flood damage, (iii) be constructed by methods and practices that minimize flood damages, and (iv) be constructed with electrical, heating, ventilation, plumbing, and air conditioning equipment and other service facilities that are designed and/or located so as to prevent water from entering or accumulating within the components during conditions of flooding.

(4) Review subdivision proposals and other proposed new development, including manufactured home parks or subdivisions, to determine whether such proposals will be reasonably safe from flooding. If a subdivision proposal or other proposed new development is in a flood-prone area, any such proposal shall be reviewed to assure that (i) all such proposals are consistent with the need to minimize flood damage within the flood-prone area.

Sec. 60.3(b)

(5) Where base flood elevation data are utilized, within Zone A on the community's FHBM or FIRM:

(i) Obtain the elevation (in relation to mean sea level) of the lowest floor (including basement) of all new and substantially improved structures, and

(ii) Obtain, if the structure has been flood proofed in accordance with paragraph (c)(3)(ii) of this section, the elevation (in relation to mean sea level) to which the structure was floodproofed.

(iii) Maintain a record of all such information with the official designated by the community under Sec. 59.22(a)(9)(iii);

(6) Notify, in riverine situations, adjacent communities and the State Coordinating Office prior to any alteration or relocation of a watercourse, and submit copies of such notifications to the Administrator;

(7) Assure that the flood carrying capacity within the altered or relocated portion of any water course is maintained;

(8) Require that all manufactured homes to be placed within Zone A on a community's FHBM or FIRM shall be installed using methods and practices which minimize flood damage. For the purposes of this requirement, manufactured homes must be elevated and anchored to resist flotation, collapse or lateral movement. Methods of anchoring may include but are not to be limited to, use of over-the-top or frame ties to ground anchors. This requirement is in addition to applicable State and local anchoring requirements for resisting wind forces.

McKinney Homeless Assistance Act of 1988

As a result of the Special Legislation passed by Congress in November, 1988, as a part of the McKinney Homeless Assistance Act, flood elevation maps in effect in the Sacramento area at the time of passage of the legislation will remain in effect for four years. When the FIRM for the Sacramento area was updated, new elevations resulting from the USCOE study were not shown on the maps. Areas shown as AE Flood Hazard Zone on the February 1988 Effective FIRM continue to be shown as AE (with the previous elevations) on the May 1989 Preliminary FIRM. FEMA has decided to apply and the A99 Flood Hazard zone designation was applied to those areas that were not previously in the 100-year flood plain, but were determined to be

within the flood plain in the USCOE study. FEMA regulations applicable to the AE Flood Hazard zone (see Section 60 § 44 CPR, Chapter 1) continue to apply to those areas of the Sacramento area designated as AE.

FEMA regulations applying to the areas designated with the A99 Flood Hazard Zone are minimal, but are described above. However, FEMA has stated that "the Sacramento area jurisdictions must recognize that this will be a special use of this [A99] zone and that these requirements were designed only for those situations where 100-year flood protection was assured in the near future. Since this is not the case in the Sacramento area, local jurisdictions should be judicious in their establishment and application of appropriate flood plain management criteria, based on their knowledge of the risk involved." (Letter from Harold T. Duryee, Administrator, FIA, to Congressmen Vic Fazio and Robert Matsui.)

Requirements Related to Lending

Designation of an area as being within a flood hazard zone requires flood insurance as a condition of Federally backed financing. Federally guaranteed or funded loan programs have additional requirements, as described below.

Private Lenders

Most private lenders, including banks, savings and loans, and credit unions are regulated by one or more federal programs, including FSLIC or FDIC, and are therefore obligated to require flood insurance and provide notice of the property's location in the 100-year flood plain. Flood insurance is required as a condition of a loan for structures in the Flood Hazard A zones by Federal law, and lenders sometimes require such insurance for structures in the B zones (Hamilton, 1989).

Loans that originate with private lenders are often Federally guaranteed or sold to Fannie Mae or other federally connected organizations. This triggers a requirement to follow FEMA regulations, including requiring flood insurance for all structures located in Flood Hazard A zones.

Public Lenders

The Federal Housing Agency (FHA), the Veteran's Administration (VA), and the Farmer's Home Administration all loan or guarantee loans for residential structures. The Flood Disaster Protection Act of 1973 requires purchase of flood insurance as a condition of receiving any form of Federal or federally related financial assistance for acquisition or construction purposes with respect to insurable buildings and mobile homes within a special flood hazard area. Because of this requirement, the FHA, VA, and the Farmer's Home Administration all require flood insurance for all new and existing structures located in Flood Hazard A zones.

In addition to requiring flood insurance, these federal agencies are required to comply with Executive Order 11298, which requires federal agencies not to encourage development in a flood plain. Because of this federal policy, these agencies must go through a clearance procedure before they guarantee loans for new construction in the flood plain (Flood Hazard A zones). The clearance procedure involves determining whether there are alternate sites available for the project that are not located in the flood plain, and, if there are not, to determine mitigation for construction in the flood plain (generally implementing the FEMA requirements above) and to notify the public and accept public comments on the agency's proposal to allow development in the flood plain (Bolton, 1989 and Wilson, 1989).

IMPACTS AND MITIGATION MEASURES

Introduction

The Proposed Land Use Policy was evaluated against existing plans and policies. A significant impact was determined to occur if the policy would allow development inconsistent with existing plans and policies. The stated degree of significance and/or consistency analysis is based on the current information available regarding the proposed project design options. A project impact is considered to be significant if it does not conform with one of the goals of the City's approved plans.

City of Sacramento Plans and Regulations

City of Sacramento General Plan

- ✱ **The Proposed Land Use Policy is not consistent with City General Plan policies related to flooding. This is a *significant impact*.**

City General Plan policy requires that the city protect against flood related hazards wherever feasible and also prohibit development of areas subject to unreasonable risk of flooding unless measures can be implemented to eliminate or reduce the risk of flooding. While the General Plan does not have a goal for a specific level of flood protection, the Plan itself uses the 100-year flood plain as a basis for analysis.

The Proposed Land Use Policy would allow development in areas subject to the 100-year flood. The Policy requires the following measures to reduce the risk of flooding: 1) residential structures in projects for which entitlement applications are filed after April 1, 1989 must be built in accordance with the USCOE January 1989 Working Maps; 2) non-residential structures receiving plan checks after April 1, 1989 must be designed to resist flood damage by floodproofing lower levels and equipment; and 3) for structures in projects for which entitlement applications were filed or plan checks were received before April 1, 1989, there are no measures to reduce the risk of flooding.

For those structures located in the Pocket or Natomas areas which are subject to approval after April 1, 1989, the Policy is consistent with the General Plan policy. For structures which are located outside of the Pocket or Natomas areas which are

built as part of projects for which entitlement applications were filed or plan checks received before April 1, 1989, the Policy is not consistent with the General Plan policy.

Mitigation Measures

Any one of the following mitigation measures would reduce this impact to a less-than-significant level.

1. *Amend the Proposed Land Use Policy to add measures to reduce the risk of flood damage for all structures to be located in areas subject to the 100-year flood.*

Measures to reduce the risk of flood damage could include requirements to raise the elevation of the building pad or of the first floor of the structure one foot above the level of the 100-year flood.

2. *Amend the City General Plan to define "areas subject to unreasonable risk of flooding" in Policy 1 to exclude areas designated A99 Flood Hazard zone on the FIRM for the area. This measure would reduce the inconsistency with the City General Plan by modifying the General Plan.*

City of Sacramento Flood Control Regulations

- ✱ **The Proposed Land Use Policy will be consistent with the existing City Flood Hazard regulations. This is *not* a significant impact.**

Flood hazard zones in the City are based on the February 1988 Effective FIRM for the community. Those areas designated A99 Flood Hazard zone on the May 1989 Preliminary FIRM for Sacramento will not be subject to the City regulations concerning flood hazard, because there are no City regulations for the A99 Zone. Since the Proposed Land Use Policy will not effect existing regulations for those areas designated as flood hazard zones on the February 1988 Effective FIRM, the policy would be consistent with existing City flood control regulations.

Mitigation Measures

3. *None required.*

County of Sacramento Plans and Regulations

County of Sacramento General Plan

County General Plan policies are directed at limiting development in areas subject to flooding. Policy 2.4.17 prohibits "urban-type" uses on unprotected flood land.

- ⌘ **The proposed Land Use Policy is not consistent with County General Plan policies related to flooding. This is a *significant impact*.**

Mitigation Measures

Any one of the following mitigation measures would reduce this impact to a less-than-significant level.

4. *Amend the Proposed Land Use Policy to add measures to reduce the risk of flooding for all structures to be located in areas subject to the 100-year flood.*
5. *Amend the County General Plan to define "unprotected flood land" to exclude areas designated A99 Flood Hazard zone on the FIRM for the area. This measure would reduce the inconsistency with the County General Plan by modifying the General Plan.*

County of Sacramento Flood Control Regulations

- ⌘ **The Land Use Policy will be consistent with the existing County Flood Hazard regulations. This is *not a significant impact*.**

Flood hazard zones in the County are based on the February 1988 Effective FIRM for the region, those areas designated A99 Flood Hazard Zone on the May 1989 Preliminary FIRM for Sacramento will not be subject to the County F Zone regulations, because there are no County regulations for the A99 Zone. Since the Proposed Land Use Policy will not replace existing regulations for those areas previously designated as flood hazard zones, the Proposed Land Use Policy will be consistent with existing County ordinances.

Mitigation Measures

6. *None required.*

State Plans and Regulations

Department of Fish and Game Streambed Alteration Agreement

- ⌘ **A Streambed Alteration Agreement will be necessary for some development that takes place within the 100-year flood plain. This is a *less-than-significant impact*.**

The Department of Fish and Game (DFG) requires that a Streambed Alteration Agreement with the DFG be entered into prior to work within the 100-year flood plain of any waterway.

The notification (with fee) and subsequent agreement, must be completed prior to initiating any such work. Notification to the DFG should be made after the project is approved by the lead agency.

Mitigation Measures

7. *None required.*

Federal Plans and Regulations

National Flood Insurance Program

- ✱ **The Proposed Land Use Policy will be consistent with Federal plans and regulations related to flooding. This is *not a significant impact*.**

The Special Legislation prohibits application of FEMA regulations to any of the areas designated A99 Flood Hazard Zone on the May 1989 Preliminary FIRM other than those areas designated AE on the May 1988 Effective FIRM. Therefore the Proposed Land Use Policy would not be inconsistent with Federal plans and regulations related to flooding.

Mitigation Measures

8. *None required.*

5.3 LAND USE

SETTING

The Proposed Land Use Policy would provide special guidance for land uses in areas which have been identified as within the A-99 Zone as defined on the May 1989 Preliminary FIRM and for those areas which would be exposed to flooding from a levee failure along the Sacramento River. In order to evaluate the magnitude of the effect of this policy, it is necessary to understand the projected levels of growth within areas which are within the flood plain, and the manner in which the Proposed Land Use Policy may affect projected growth patterns. The following discussion is intended to provide the context for the risk assessment contained in Chapter 5.4, Flood Hazards.

Location of the 100-Year Flood Plain

Existing (February 1988 FIRM)

The 100-Year flood plain, as defined in the February 1988 FIRM, is primarily affected by Dry Creek and Arcade Creek in North Sacramento, and Morrison Creek stream group in South Sacramento.

Future (May 1989 Preliminary FIRM)

In May 1989, FEMA published a preliminary FIRM based on the January 1989 USCOE Working Maps. This May 1989 Preliminary FIRM depicted a greatly expanded 100-year flood plain. The new flood plain covers areas included in the February 1988 Effective FIRM, as well as all of Natomas, large portions of North Sacramento (north of the American River and west of McClellan Air Force Base), the Pocket Area, and large portions of the downtown area, South Sacramento and the Meadowview area (see Figure 1 on page 26).

Existing Levels of Development

Population

As of 1988, a total of approximately 370,000 people lived in the newly identified 100-year flood plain, consisting of about 30,350 people in Natomas, 40,400 people in the Pocket Area, and about 299,250 people elsewhere in the flood plain. Table 5 provides a summary of 1988 population in the 100-year flood plain.

TABLE 5
PROJECTED POPULATION GROWTH IN THE FLOOD PLAIN
(In Thousands)

| | 1988 | 1988-1992 Growth | 1992 | 1992-1997 Growth | 1997 | 1997-2010 Growth | 2010 | 1997-2010 Annual Growth |
|---------------------------------|------|---------------------|------|---------------------|------|---------------------|------|-------------------------------|
| Natomas | 30 | 4 | 34 | 4 | 38 | 66 | 104 | 5 |
| Pocket | 40 | 2 | 43 | 1 | 44 | 40 | 44 | .03 |
| Remainder of the Flood Plain | 296 | 21 | 317 | 23 | 340 | 62 | 402 | 5 |
| ∞ Total Flood Plain | 366 | 27 | 393 | 28 | 422 | 129 | 551 | 10 |

SOURCE: SACOG; City of Sacramento; EIP Associates.

Housing

In 1988, there were a total of about 160,000 housing units (single-family and multi-family) in the new 100-year flood plain. Of this total, about 13,200 units were located in the Natomas area, about 16,300 units were in the Pocket Area and the remaining 130,500 units were elsewhere in the flood plain area. Table 6 provides a summary of the number of housing units in the 100-year flood plain during 1988.

Non-Residential Development

SACOG has generated projections of employment growth in the Sacramento region. Using standard factors from the City of Sacramento General Plan, these employment projections have been translated into projections of growth in non-residential square footage. It is estimated that, as of 1988, there was a total of about 75,015,000 square feet of non-residential development throughout the entire 100-year flood plain, including about 10,120,000 square feet of retail space and about 64,894,000 square feet of non-retail space (i.e. office, manufacturing, light industrial, heavy industrial, etc.). For Natomas, it is estimated that there was a total of about 330,000 square feet of retail space and about 3,774,000 square feet of non-retail space. In the Pocket Area it is estimated that there was about 336,000 square feet of retail space and about 1,003,000 square feet of non-retail space. In the remainder of the 100-year flood plain, there was estimated to be a total of about 9,452,000 square feet of retail space and about 60,117,000 square feet of non-retail space. Nearly one-half of this space is located in the greater Downtown area (see Table 7).

Projections of Future Growth

Population

Population Growth Throughout the Flood Plain

The population in the new 100-year flood plain is projected to increase from about 370,000 to about 550,000 between 1988 and 2010 (projected buildout of the General Plans); this would represent an increase of about 180,000 people, or about 50 percent. Of the total amount of growth occurring in the new 100-year flood plain, an increase of about 27,000 people between 1988 and 1992 (an increase of 7.3 percent over the 1988 population, and 15 percent of the total 1988-2010 population increase) is projected. Between 1992 and 1997, it is projected that the population located in the flood plain would increase by about 28,000 people (an increase of about 7.1 percent over the 1992 population, and about 16 percent of the total 1988-2010 population increase). After 1997, total population in the flood plain (shown on the May 1989 Preliminary FIRM) would increase by about 9,900 people per year to a total population of about 500,000 at buildout.

TABLE 6
PROJECTED RESIDENTIAL DEVELOPMENT IN THE FLOOD PLAIN
(Number of Units in Thousands)

| | 1988 | 1988-1992 Growth | 1992 | 1992-1997 Growth | 1997 | 1997-2010 Growth | 2010 | 1997-2010 Annual Growth |
|---------------------------------|------|---------------------|------|---------------------|------|---------------------|------|-------------------------------|
| Natomas | 13 | 2 | 15 | 1 | 16 | 33 | 49 | 3 |
| Pocket | 16 | .1 | 17 | 1 | 17 | 1 | 19 | .07 |
| Remainder of the Flood Plain | 129 | 9 | 139 | 5 | 144 | 32 | 181 | 3 |
| ∞ Total Flood Plain | 159 | 12 | 171 | 7 | 177 | 66 | 249 | 6 |

SOURCE: SACOG; City of Sacramento; EIP Associates.

TABLE 7

PROJECTED NON-RESIDENTIAL DEVELOPMENT IN THE FLOOD PLAIN
(Square Feet In Thousands)

| | 1988 | 1988-1992 Growth | 1992 | 1992-1997 Growth | 1997 | 1997-2010 Growth | 2010 | 1997-2010 Annual Growth |
|----------------------------|--------|---------------------|--------|---------------------|---------|---------------------|---------|----------------------------|
| <u>Natomas</u> | | | | | | | | |
| Retail | 330 | 50 | 380 | 29 | 409 | 1,158 | 1,567 | 89 |
| Non-Retail | 3,774 | 1,069 | 4,848 | 611 | 5,454 | 24,553 | 30,006 | 1,889 |
| Subtotal | 4,104 | 1,119 | 5,223 | 640 | 5,863 | 25,711 | 31,573 | 1,978 |
| <u>Pocket</u> | | | | | | | | |
| Retail | 336 | 44 | 380 | 55 | 435 | 142 | 577 | 11 |
| Non-Retail | 1,003 | 260 | 1,262 | 324 | 1,587 | 843 | 2,430 | 65 |
| Subtotal | 1,339 | 304 | 1,642 | 379 | 2,022 | 985 | 3,007 | 76 |
| <u>Rest of Flood Plain</u> | | | | | | | | |
| Retail | 9,459 | 891 | 10,350 | 1,247 | 11,597 | 1,836 | 13,433 | 141 |
| Non-Retail | 60,117 | 12,087 | 72,205 | 14,097 | 86,301 | 29,430 | 115,731 | 2,264 |
| Subtotal | 69,576 | 12,978 | 82,555 | 15,344 | 97,898 | 31,266 | 129,164 | 2,405 |
| <u>Total Flood Plain</u> | | | | | | | | |
| Retail | 10,125 | 985 | 11,110 | 1,330 | 12,440 | 3,136 | 15,576 | 241 |
| Non-Retail | 64,894 | 13,416 | 78,310 | 15,032 | 93,342 | 54,826 | 148,168 | 4,217 |
| Total | 75,019 | 14,401 | 89,420 | 16,362 | 105,782 | 57,962 | 163,744 | 4,458 |

SOURCE: SACOG; City of Sacramento; EIP Associates.

Population Growth in Natomas

The population in Natomas, all of which lies within the 100-year flood plain, is projected to increase from about 30,300 to about 104,000 between 1988 and 2010 (projected buildout of the General Plans). This would represent an increase of about 74,000 people, or about 244 percent. Of the total amount of growth in Natomas, there would be an increase of about 3,800 people between 1988 and 1992 (an increase of 12.5 percent over the 1988 population, and 5.1 percent of the total 1988-2010 population increase). Between 1992 and 1997, it is projected that the population in Natomas would again increase by about 3,800 people (an increase of about 11.1 percent over the 1992 population, and about 5.1 percent of the total 1988-2010 population increase). After 1997, total population in Natomas would increase by about 5,100 people per year to a total population of about 104,000 at buildout.

Population Growth in the Pocket Area

The population in the Pocket Area, all of which lies within the 100-year flood plain, is projected to increase from about 40,400 to about 44,000 between 1988 and 2010 (projected buildout of the General Plans). This would represent an increase of about 3,600 people, or about 8.9 percent. Of the total amount of growth in the Pocket Area, there would be an increase of about 2,100 people between 1988 and 1992 (an increase of 5.2 percent over the 1988 population, and 58 percent of the total 1988-2010 population increase). Between 1992 and 1997, it is projected that the population in the Pocket Area would again increase by about 1,200 people (an increase of about 2.9 percent over the 1992 population, and about 34 percent of the total 1988-2010 population increase). After 1997, total population in the Pocket Area would increase by about 31 people per year to a total population of about 44,000 at buildout.

Housing

Housing Growth Throughout the Flood Plain

The housing stock in the area currently covered by the 100-year flood plain is projected to increase from 160,000 units to about 250,000 units between 1988 and 2010 (projected buildout of the General Plans); this would represent an increase of about 90,000 units, or about 56 percent. Of the total amount of growth under the flood plain, there would be an increase of about 11,500 units between 1988 and 1992 (an increase of 7.2 percent over the 1988 housing stock, and 12.8 percent of the total 1988-2010 housing unit increase). Between 1992 and 1997, it is projected that the housing stock located in the flood plain would increase by about 6,600 units (an increase of about 3.9 percent over the 1992 housing stock, and about 7.4 percent of the total 1988-2010 increase in housing units). After 1997, total population in the flood plain (if it continues to exist) would increase by about 5,100 units per year to a total housing stock of about 250,000 units at buildout.

Housing Growth in Natomas

Housing units in Natomas are projected to increase from about 13,200 to about 49,300 between 1988 and 2010 (projected buildout of the General Plans); this would represent an increase of about 36,100 units, or about 273 percent. Of the total amount of growth in Natomas, there would be an increase of about 1,651 units between 1988 and 1992 (an increase of 12.5 percent over the 1988 housing stock, and 4.6 percent of the total 1988-2010 increase in housing units). Between 1992 and 1997, it is projected that in Natomas there would be a gain of about 922 housing units (an increase of about 5.8 percent over the 1992 housing stock, and about 2.6 percent of the total 1988-2010 housing unit increase). After 1997, total population in Natomas would increase by about 2,515 units per year to a total housing stock of about 49,300 units at buildout.

Housing Growth in the Pocket Area

The amount of housing in the Pocket Area is projected to increase from about 16,300 in 1988 to about 18,600 in 2010; this would represent an increase of about 2,400 units, or about 14.5 percent. Of the total amount of growth in the Pocket Area, about 800 units would be added between 1988 and 1992 (an increase of 4.9 percent over the 1988 housing stock, and 34 percent of the total 1988-2010 housing unit increase). Between 1992 and 1997, it is projected that the housing stock in the Pocket Area would increase by about 340 units (an increase of about 2 percent over the 1992 housing stock, and about 14 percent of the total 1988-2010 housing increase). After 1997, total housing stock in the Pocket Area would increase by about 31 units per year to a total housing stock of about 44,000 at buildout.

Non-Residential Development

Non-Residential Development Throughout the Flood Plain

Non-residential development (retail, office, industrial and other commercial uses) in the area currently covered by the 100-year flood plain is projected to increase from 75 million square feet of space to about 164 million square feet between 1988 and 2010 (projected buildout of the General Plans); this would represent an increase of about 89 million square feet, or about 119 percent growth in total square footage over the next 22 years. Of the total amount of growth, about 94 percent of the growth would be in non-retail development (about 83 million square feet), with the remaining 6 percent being retail development (about 5.5 million square feet).

There would be an increase of about 14.4 million square feet between 1988 and 1992 (an increase of about 19 percent over the 1988 level of development, and 16 percent of the total 1988-2010 increase in non-residential development). Between 1992 and 1997, it is projected that the non-residential development located in the flood plain would increase by about 31 million square feet (an increase of about 35 percent over the 1992 level of non-residential development, and about 35 percent of the total 1988-2010 increase in non-residential development). After 1997, total non-

residential construction in the flood plain (if it continues to exist) would increase by about 3.9 million square feet per year to a total square footage of about 164,000 square feet at buildout.

Non-Residential Development in Natomas

Non-residential development (retail, office, industrial and other commercial uses) in Natomas is projected to increase from 4.1 million square feet of space to about 31.6 million square feet between 1988 and 2010 (projected buildout of the General Plans); this would represent an increase of about 27.5 million square feet, or about 670 percent growth in total square footage over the next 22 years. Of the total amount of growth, about 95 percent of the growth would be in non-retail development (about 26.2 million square feet), with the remaining 5 percent being retail development (about 1.2 million square feet).

There would be an increase of about 1.1 million square feet between 1988 and 1992 (an increase of about 27 percent over the 1988 level of development, but only 4 percent of the total 1988-2010 increase in non-residential development). Between 1992 and 1997, it is projected that the non-residential development located in Natomas would increase by about 600,000 square feet (an increase of about 12.3 percent over the 1992 level of non-residential development, and about 2.4 percent of the total 1988-2010 increase in non-residential development). After 1997, total non-residential construction in Natomas would increase by about 2.0 million square feet per year to a total square footage of about 32 million square feet at buildout.

Non-Residential Development in the Pocket Area

Non-residential development (retail, office, industrial and other commercial uses) in the Pocket Area is projected to increase from 1.3 million square feet of space to about 3.0 million square feet between 1988 and 2010 (projected buildout of the General Plans); this would represent an increase of about 1.7 million square feet, or about 130 percent growth in total square footage over the next 22 years. Of the total amount of growth, about 86 percent of the growth would be in non-retail development (about 1.4 million square feet), with the remaining 14 percent being retail development (about 240 thousand square feet).

There would be an increase of about 304,000 square feet between 1988 and 1992 (an increase of about 23 percent over the 1988 level of development, and 18 percent of the total 1988-2010 increase in non-residential development). Between 1992 and 1997, it is projected that the non-residential development located in the Pocket area would increase by about 380,000 square feet (an increase of about 23 percent over the 1992 level of non-residential development, and about 23 percent of the total 1988-2010 increase in non-residential development). After 1997, total non-residential construction in the flood plain in the Pocket Area (if it continues to exist) would increase by about 985,000 square feet per year to a total square footage of about 3 million square feet at buildout.

IMPACTS AND MITIGATION MEASURES

Introduction

The land use analysis evaluates the consistency of the Proposed Land Use Policy with the projected land use patterns in the area that would be affected by the new 100-year flood plain and, hence, by the proposed policy. An impact is considered to be significant if it substantially changes the type or intensity of land uses that could be developed in the area.

Methodology

The characteristics of the Proposed Land Use Policy were evaluated against the characteristics of the development process independent of the policy. Conclusions were drawn related to the degree of change that the Proposed Land Use Policy would make in the development processes that were in place during the time that future growth in the City and County were projected.

Impacts and Mitigation Measures

- ✱ **The Proposed Land Use Policy would eliminate the possibility of any annexations under the City, or General Plan amendments (City or County) that would result in an increase in urbanization or the conversion of agricultural land. This is not considered a *significant impact*, and could be considered a *beneficial impact*.**

The Proposed Land Use Policy, if adopted by both the City and the County, would not allow either jurisdiction to adopt amendments to their General Plans that would result in an overall increase in urbanization (i.e., intensity of development and/or use of the land) or the conversion of agricultural land. This element of the Proposed Land Use Policy would restrict growth to that which is currently accounted for by the projections that are based on development of land currently designated for urban development. As such, no reduction in development would be imposed by this element of the Proposed Land Use Policy.

The conversion of prime agricultural lands is considered to be a significant impact by the State Department of Conservation. To the extent that the Proposed Land Use Policy would eliminate the possibility of unforeseen conversions of agricultural land, the policy could be said to provide beneficial impacts through the protection of some existing agricultural lands.

Mitigation Measures

9. *None required.*

- ✱ **The Proposed Land Use Policy would not measurably decrease the amount of development and growth to occur in the 100-year flood plain during the 1988 to 1997 time period. This is considered a *less-than-significant impact*.**

The Proposed Land Use Policy would be intended to be in effect for a period of approximately six to seven months, from December 1989 until July 1, 1990. The Sacramento Metropolitan Flood Protection Task Force has stated that it anticipates recommending rescission of the policy on or about July 1, 1990, corresponding with the letting of contracts for the levee stabilization project. Assuming that the Sacramento City Council and the Sacramento County Board of Supervisors impose the Proposed Land Use Policy for a period of about six months, it is unlikely that there would be any measurable effect of the policy on overall levels of development.

For residential development, only projects for which applications were/will be submitted between April 1, 1989 and July 1, 1990 would be restricted by the Proposed Land Use Policy, which eliminates the ability of these projects to acquire a building permit during the period the Proposed Land Use Policy is in effect. However, due to the normal lengths of time for processing of project approvals and building permit documents, it is unlikely that any but the smallest projects would be hindered. If, in fact, several projects are delayed, the delay would be for a relatively short time. Essentially the same amount of residential development would occur under the Proposed Land Use Policy as that projected for development prior to the policy. See discussion of Projections of Future Growth, page 66.

For non-residential development, the Proposed Land Use Policy contains very little hindrance to future development. The design requirements would not be likely to limit the development of any substantial amount of non-residential development.

For the purposes of this analysis, it is concluded that the levels of residential and non-residential development projected for the future in the flood plain area would not change with the imposition of the Proposed Land Use Policy.

Mitigation Measures

10. *None required.*

5.4 FLOOD HAZARDS/PUBLIC HEALTH AND SAFETY

SETTING

The risk of exposure to flooding is determined by two primary factors: the hydrology and topography of the flood plain, and the type and amount of development located in the flood plain. Chapter 4 provides an in-depth discussion of the existing flood hazard conditions, including the hydrology of the Sacramento and American river systems, the history of flooding and flood control in the Sacramento region, local responses to flooding concerns and typical hazards related to flooding. Chapter 5.3, Land Use, provides detailed information about the existing and projected level of development (in terms of population, housing units, and non-residential development in the flood plain area. These two chapters provide the setting for the discussion of impacts and mitigation measures related to flood hazards, which follows below.

IMPACTS AND MITIGATION MEASURES

Introduction to the Analysis

The degree of risk to human life and property is determined by the probability of exposure to flooding and the severity of harm posed; that is, the likelihood of exposure, in addition to the severity of the flood.

The Proposed Land Use Policy was analyzed for impacts due to flooding within areas identified in the May 1989 Preliminary FIRM and the Sacramento River Levee Failure Map. The risk assessment will also analyze potential impacts under the following flood protection scenarios designed to incrementally achieve 100-year flood protection in the Sacramento Metropolitan Area:

- ☐ Existing level of flood protection
- ☐ Levee stabilization
- ☐ Additional upstream storage and levee improvements

A significant impact would occur if, as a result of the project, any deaths and/or property damage occurred during a 100-year or lesser flood as a result of any new development allowed by the Proposed Land Use Policy.

Methodology for the Analysis

The 100-Year Flood Plain

The 100-year flood plain was identified by using FEMA's May 1989 Preliminary FIRM based on the January 1989 Working Maps. Figure 1, page 26, represents the area of Sacramento County covered by the proposed 100-year flood plain. The

preliminary FIRM includes the areas within the 100-year flood plain identified in the 1988 Effective FIRM.

Levels of Flood Protection

The 100-year flood or "base flood" is defined as the flood having a 1 percent chance of being equalled or exceeded in any given year.

Physical Flood Protection Improvements

This analysis assumes the completion of certain flood control improvements by specific dates. Levee stabilization is assumed to be completed in 1992; and some combination of levee improvements and additional upstream storage is assumed to be implemented in 1997. The three essential elements of the physical flood control effort are described below.

Levee Stabilization

The first element of the Sacramento flood control effort is stabilization of 32 miles of levees along the Sacramento River that are in need of remedial work to correct latent construction defects. When completed, this work will allow the levees to perform as originally designed. The estimated cost of repairing these levees is \$38 million. The effect of this stabilization project will be to provide the Natomas area with an approximate 50-year level of flood protection. Flood protection in other areas will be approximately 63-year due to flooding from the American River. The USCOE is currently awaiting approval to begin engineering and design work to correct the levee deficiencies. Prior to the start of this project, environmental evaluation under the provisions of the National Environmental Protection Act (NEPA) will be undertaken. It is anticipated that this project will be completed by 1992.

Additional Upstream Storage and Levee Improvements

The second element of the Sacramento Flood control effort is additional upstream storage.

Additional upstream storage could be obtained on a temporary basis through the reoperation of Folsom Dam. This project would involve reserving greater storage capacity in Folsom Lake during the November to April wet season. Provision of an additional 190,000 acre-feet of storage (over existing storage levels) in Folsom Lake would bring the total storage capacity up to approximately 600,000 acre-feet. This increased capacity would provide 100-year protection for the entire Sacramento metropolitan area with the exception of Natomas and areas located in the 100-year flood plain identified on the February, 1988 Effective FIRM.

Another way to provide additional upstream storage is to use existing upstream reservoir space for flood control.

Existing reservoirs upstream from Folsom Dam have a cumulative storage capacity of about 820,000 acre-feet (see Figure 4 on page 34). According to the USCOE American River Watershed Investigation Reconnaissance Report, "All of these reservoirs are used for water supply and/or hydroelectric power generation. None have designed flood control space. Since the reservoirs are at relatively high elevations, where much of the precipitation occurs as snow, they have minimal effect on floodflow reduction."

According to the USCOE in the American River Watershed Investigation Reconnaissance Report, there are conceptually two ways to obtain additional flood protection from these upstream reservoirs. One is to purchase flood control space from existing upstream reservoir capacity. The second would be to modify flood control operation of Folsom Dam in order to take advantage of any incidental available space. The USCOE, after studying the first alternative, determined that the annual cost of purchasing upstream reservoir storage space would exceed the flood control benefits by about two to one and was, therefore, not recommended for further consideration.

Evaluation of the second alternative showed that in many years a slightly increased level of flood control could be achieved with the incidental available spaces indicated in existing upstream reservoirs. However, full storage space in Folsom Dam would be required in some years when upstream storage was unavailable. The USCOE determined that giving credit for space in upstream reservoirs is believed to have potential when considered in combination with other measures for helping increase flood protection.

According to the USCOE American River Watershed Investigation Reconnaissance Report, additional flood storage can also be achieved by construction of either a single-purpose dam and reservoir or providing space in a new multipurpose facility upstream from Folsom Dam. To achieve 100-year protection, given the existing storage space of 400,000 acre-feet in Folsom, an additional 190,000 acre-feet of upstream storage would need to be provided. Potential reservoir sites in the Upper American River Basin according to the USCOE, are listed in Table 8.

Levee Improvements

The third element of the Sacramento Flood Control effort involves improvement of certain sections of the levee system protecting Sacramento. This will entail raising the height of these sections, in an effort to provide additional flood protection. It is anticipated that levee improvement along portions of Sacramento River, American River, Natomas East Main Drainage Canal (NEMDC), Pleasant Grove Creek Canal, Dry Creek, Arcade Creek, and Morrison Creek, in combination with additional upstream storage and levee stabilization will provide the greater Sacramento Area with 100-year protection.

According to the USCOE American River Watershed Investigation Reconnaissance Report, to decrease the likelihood of failure of the NEMDC west levee system due to 100-year flooding, about three miles of this system must be raised an average of three feet immediately downstream from Dry Creek, seven miles of the

TABLE 8
POTENTIAL RESERVOIR SITES
IN THE UPPER AMERICAN RIVER BASIN

| Site | Stream ¹ | Drainage Area (Sq.Mi.) | Average Annual Runoff (Ac-Ft/Yr) | Reservoir Storage Capacity (Ac-Ft/Yr) |
|----------------|---------------------|------------------------------|---|--|
| Granite Canyon | N.F. | 96 | 226,000 | 300,000 |
| Giant Gap | N.F. | 200 | 396,000 | 650,000 |
| Growlersburg | M.F. - Canyon Rd. | 12 | 13,900 | 17,500 |
| Salmon Falls | S.F. | 807 | 940,000 ² | 200,000 ³ |
| Alder | S.F. - Alder Creek | 19 | 18,600 | 80,000 |
| Auburn | N.F. and M.F. | 982 | 1,486,000 | 2,300,000 |

¹ N.F. = North Fork American River; M.F. = Middle Fork American River; S.F. = South Fork, American River.

² Does not include adjustments for upstream regulation.

³ Maximum capacity which will not inundate gold discovery site at Coloma.

SOURCE: USCOE American River Watershed Investigation Reconnaissance Report.

system levee from Elkhorn Boulevard to Sankey Road must be raised about one foot and all bridges over the canal except the Silver Eagle and I-80 bridges must be raised.

During high flows, the above modifications would induce flooding in the Dry and Arcade creek areas. To mitigate this impact the USCOE would require the following:

- ✧ Raise the east levee of the NEMDC from the mouth at the American River to Dry Creek.
- ✧ Construct about four miles of new levee approximately 15 feet high along the east bank of the NEMDC from near Elverta Road to the confluence of Dry Creek and continuing upstream along the north side of Dry Creek to near Marysville Boulevard.
- ✧ Extend the existing south levee along Dry Creek to the Magpie Diversion Canal.
- ✧ Excavate and widen about three miles of the channel in Dry Creek from near Marysville Boulevard up the south side of Cherry Island.
- ✧ Raise the north levee along Arcade Creek from the NEMDC to Marysville Boulevard two feet.
- ✧ Raise 0.3 miles of south levee along Arcade Creek upstream from Marysville Boulevard.
- ✧ Construct 0.4 miles of new levees on both sides of Arcade Creek upstream from Marysville Boulevard to a height of about three feet.
- ✧ Raise or replace the bridges over Dry Creek at Elkhorn Boulevard, Rio Linda Boulevard, and Dry Creek Road.
- ✧ Raise or replace the bridges over Arcade Creek at Norwood Avenue and Marysville Boulevard. (The bridge at Rio Linda Boulevard is being replaced by the City of Sacramento.)

If levees were raised along the Natomas Cross Canal and Pleasant Grove Creek Canal, there would be an increase in potential flooding of the area northeast of the Pleasant Grove Canal. To mitigate the impacts associated with this increase, the USCOE recommended raising levees and bridges along the canals.

To upgrade the levees along the Sacramento and American Rivers adjacent to Natomas to accommodate 100-year flows would include the following:

- ✧ Raise the east levee of the Sacramento River one foot from the Natomas Cross Canal downstream for about five miles.
- ✧ Raise the north levee of the American River from the NEMDC downstream for about 1.5 miles one to two feet.

- ▣ Place stone protection along the north levee of the American River from the NEMDC to the Sacramento River.

Table 9 represents potential levels of flood protection within the study area based on information received from the USCOE. Table 10 represents the percent likelihood of occurrence for a given year, and over a series of years, of the projected levels of flood protection.

It was assumed for the purposes of this study that in 1997, with levee stabilization along the Sacramento River, additional upstream storage for the American River, and levee improvements along both river systems and the NEMDC, that 100-year protection is achieved.

The risk being evaluated in this study is that associated with the 100-year flood event. This is based on the availability of information on the extent and depth of the 100-year flood plain. However, the actual flood protection provided by the levee systems in the study area varies and there exists the possibility that a storm of a magnitude less than 100-year could produce flooding in some areas of the region. The level of protection afforded by a particular section of the levee system is determined by the physical capacity of the river channel (in terms of cfs). In some areas, the USCOE has altered its conclusions about the level of protection based on available information about the structural stability of the levee system. In a given reach of river, there can be varying degrees of protection provided by different subsections of the levee system. The level of protection reported for any given reach of river is based on the lowest level of protection provided in that reach of river. This lower level of protection results in a higher likelihood of flooding in any given year. For example, in Natomas where it has been identified that the levees currently have approximately 40-year protection, there is a 2.6 percent chance in any given year that a flood could potentially inundate the area. Furthermore, over the four-year period between 1989 to 1992, prior to levee stabilization, there is a 9.6 percent chance of the 40-year flood potentially inundating Natomas.

The risk of potential property damage and loss of life associated with a flood of lesser magnitude than the 100-year flood can not be predicted with the information currently available. For example, the 50- and 75-year flood plains have not been mapped. It could be assumed that a storm of lesser magnitude would produce lower flood elevations and therefore the associated impacts would be somewhat less. However, due to the relatively flat terrain of the flood plain, it is presumed it would take a significant decrease in flood event magnitude to actually decrease the size of the flood plain enough to reduce potential property damage and loss of life. For example, when comparing the relationship of depth to damage for evaluating property damage (see Depth-Damage Curve, Appendix E) it takes a significant decrease in depth to result in a significant decrease in property damage.

TABLE 9
LEVELS OF FLOOD PROTECTION
(in years)

| | | 1992 | 1997 | |
|----------------------------|----|-------------------|-----------------|--------|
| | | Level of Flood | Level of Flood | |
| | | Protection | Protection with | Additi |
| | | Existing Level of | with Levee | |
| | | Flood Protection | Stabilization | Storag |
| 1988 | | | | |
| onal Upstream | | | | |
| e & Levee Improvements | | | | |
| Natomas | 40 | 50 | 100 | |
| The Pocket Area | 63 | 63 | 100 | |
| Remaining Flood Plain Area | 63 | 63 | 100 | |

SOURCE: USCOE, 1989

TABLE 10
PERCENT LIKELIHOOD OF FLOOD EVENTS OCCURRING

| Level of Flood Protection | Any Given Year ¹ | 1989 to 1992 ² | 1992 to 1997 ³ | 1989 to 1997 |
|------------------------------|--------------------------------|------------------------------|------------------------------|-----------------|
| 40-Year | 2.5 | 9.6 | -- | -- |
| 50-Year | 2 | 7.8 | 9.6 | 16.6 |
| 63-Year | 1.6 | 6.2 | 7.7 | 13.4 |
| 100-Year | 1 | 3.9 | 4.9 | 8.6 |

¹ Estimated from statistical formula shown in Appendix I.

² Before stabilization achieved.

³ After stabilization achieved.

SOURCE: USCOE; EIP Associates, 1989

Growth Projections within the 100-Year Flood Plain

The 100-year flood plain was divided into the following subareas (see Appendix D):

1. Natomas
2. Rio Linda
3. North Sacramento
4. North Downtown
5. Downtown
6. Campus Commons/Arden/North Side of American River East to Nimbus Dam
7. River Park
8. Perkins
9. La Riviera/South Side of American River East to Nimbus Dam
10. Pocket Area
11. Meadowview
12. Florin
13. Granite Park
14. Morrison Creek/North
15. Morrison Creek/South

The subareas were chosen based on similar average elevations and flood depths (Sibilsky and Yarwood, 1989).

Projections for population, residential, retail and non-retail (non-residential) development were derived using SACOG data for 1988 to 2010, and information obtained from the City of Sacramento, (see Tables 5, 6, and 7 in Section 5.3), and Sacramento County (Tholen, 1989).

The SACOG data was broken down by minor zone projections for Sacramento County. The subarea map was overlayed on a SACOG Sacramento County Minor Zone Map to identify the projections within each area.

Growth projections for population were presented as number of people; projections for residential development were presented as number of housing units (single-family and multi-family); and retail and non-retail (non-residential) projections were presented in amount of square feet.

Impacts of Flooding on Property

Introduction

As growth takes place in areas subject to flooding, more structures would potentially be damaged in a 100-year flood or lesser. Values of structures and contents (in 1989 dollars) and percent damage based on depth damage curves formulated by the USCOE were used to estimate property damage due to a 100-year flood. A significant impact would occur if new development was subject to damage as a result of a 100-year or lesser flood.

Methodology

Growth to 2010 was projected as described above, for housing units and for square feet of retail and non-retail non-residential structures. The value of property was estimated using standard factors for the value of structures and contents. Percent damage to structures was estimated using depth damage curves formulated by the USCOE that relate the percent of structures and contents damaged to the depth of flood waters in a 100-year flood.

Depth of flooding was generalized for each of the subareas described above, and the impacts aggregated for the entire study area. Effects of flooding on loss of life would be greater in the Natomas and Pocket areas than in other areas. Effects of flooding on property would be greater in the Natomas area, as the level of flood protection in that area is currently 40-year protection. The Pocket Area has a 63-year level of flood protection, the same as that for the remainder of the study area. Thus, effects of flooding on property in the Pocket Area would be similar to those in the rest of the study area. For this reason, impacts in the Natomas area are discussed separately, but impacts in the study area as a whole are discussed in the aggregate.

A more detailed description of the factors used in estimating dollar values and losses is found in the Appendix E.

Impacts and Mitigation Measures

Existing Level of Flood Protection

Natomas

- ✱ In Natomas the 100-year flood could result in approximately 501 million dollars in property damage to new development in the period from 1989 to 1992 as a result of the project (see Table 11). There is a 1 percent chance of this occurring in any given year. It can also be estimated that there is a 3.9 percent chance of the 100-year flood event occurring during this four-year period. This is a *significant impact*.

The above impact discussion is based on estimated impacts of the 100-year flood. In Natomas, however, the USCOE has estimated that the existing level of flood protection is as little as 40-year. There is a 2.5 percent chance of this occurring in any given year. It can be estimated that there is a 9.6 percent chance of the 40-year flood event occurring during this four-year period.

The impacts associated with the 40-year flood would likely be less than, but not greater than, those for the 100-year flood described above.

TABLE 11
DAMAGE TO PROPERTY DUE TO 100-YEAR FLOOD
STRUCTURES AND CONTENTS
 In Millions of (1989) Dollars

| | 1989 to 1992 Existing Level of Flood Protection | 1992 to 1997 with Stabilization | 1997 with Levee Improvements and Additional Stream Storage | 1997 to 2010 Annual Increment ¹ |
|---|--|---------------------------------------|---|--|
| <u>Natomas</u> | | | | |
| Residential | \$337 | \$210 | \$3,541 | \$401 |
| Non-Residential | | | | |
| Retail | 14 | 8 | 113 | 24 |
| Non-Retail | 150 | 86 | 765 | 265 |
| Total Non-Residential | <u>164</u> | <u>94</u> | <u>878</u> | <u>289</u> |
| Total Damage | \$501 | \$304 | \$4,419 | \$690 |
| <u>Remaining Flood Plain Area²</u> | | | | |
| Residential | \$1,531 | \$879 | \$23,311 | \$370 |
| Non-Residential | | | | |
| Retail | 219 | 307 | 2,671 | 35 |
| Non-Retail | 1,394 | 550 | 10,295 | 118 |
| Total Non-Residential | <u>1,613</u> | <u>1,938</u> | <u>12,966</u> | <u>153</u> |
| Total Damage | 3,144 | 2,817 | 36,277 | 523 |

¹ Annual increment for each year after 1997 to 2010 if no improvements are implemented.

² Including the Pocket Area.

SOURCE: EIP Associates

Remaining Flood Plain Area

- ✱ In the remaining flood plain area the 100-year flood could result in approximately 3.1 billion dollars in property damage to new development in the period from 1989 to 1992 as a result of the project (see Table 11). There is a 1 percent chance of this occurring in any given year. It can also be estimated that there is a 3.9 percent chance of the 100-year flood event occurring during this four-year period. This is a *significant impact*.

The above impact discussion is based on estimated impacts of the 100-year flood. In the remaining flood plain area, however, the USCOE has estimated that the existing level of flood protection is as little as 63-year. there is a 1.6 percent chance of this occurring in any given year. It can be estimated that there is a 6.2 percent chance of the 63-year flood event occurring during this four-year period.

The impacts associated with the 63-year flood would likely be less than, but not greater than, those for the 100-year flood described above.

Flood Protection with Levee Stabilization

Natomas

- ✱ In Natomas the 100-year flood could result in approximately 304 million dollars in property damage to new development in the period from 1992 to 1997 as a result of the project (see Table 11). There is a 1 percent chance of this occurring in any given year. It can be estimated that there is a 4.9 percent chance of the 100-year event occurring during this five-year period, and a 8.6 percent chance of the 100-year event occurring during the nine-year period from 1989 to 1997. This is a *significant impact*.

The above impact discussion is based on estimated impacts of the 100-year flood. In Natomas, however, the USCOE has estimated that the level of flood protection with stabilization is as little as 50-year. There is a 2 percent chance of this occurring in any given year. It can be estimated that there is a 9.6 percent chance of the 50-year flood event occurring during this five-year period. In combination with exposure to the 40-year event during the 1989 to 1992 period, it can be estimated that there would be a 19.2 percent chance of a flood event occurring during the nine-year period from 1989 to 1997.

The impacts associated with the 50-year flood would likely be less than but not greater than those for the 100-year flood described above.

Remaining Flood Plain Area

- ✱ In remaining flood plain areas the 100-year flood could result in approximately 2.8 billion dollars in property damage to new development in the period from 1992 to 1997 as a result of the project (see Table 11). There is a 1 percent chance of this occurring in any given year. It can also be estimated that there is a 4.9 percent chance of the 100-year event occurring

during this five-year period, and a 8.6 percent chance of the 100-year event occurring during the nine-year period from 1989 to 1997. This is a *significant impact*.

The above impact discussion is based on estimated impacts of the 100-year flood. In the remaining flood plain area, however, the USCOE has estimated that the level of flood protection with stabilization is as little 63-year. There is a 1.6 percent chance of this occurring in any given year. It can be estimated that there is a 7.7 percent chance of the 63-year flood event occurring during this five-year period, and a 13.4 percent chance of the 63-year event occurring during the nine-year period from 1989 to 1997.

The impacts associated with the 63-year flood would likely be less than but not greater than those for the 100-year flood described above.

Mitigation Measures

Implementation of Mitigation Measure 11 would mitigate these impacts to a less-than-significant level, as no development subject to damage in a 100-year flood would be constructed.

11. *Prohibit development in those areas shown to be subject to the 100-year flood on USCOE working maps, unless that development can comply with FEMA requirements for development in an AE flood hazard zone.*

FEMA requirements include raising the first floor for residential structures at or above the level of the 100-year flood. Section 5.2 sets forth specific requirements of the National Flood Insurance Program for the AE flood hazard zone.

Implementation of Mitigation Measure 12 would mitigate this impact, but not to a less-than-significant level, as 100-year flood protection measures would not be feasible on a project basis for all areas or all types of development.

12. *Require flood protection measures (such as floodproofing, elevated structures or ring levees) for each project as a condition of development.*

Some developments could be protected by levees around the development itself or other flood protection measures constructed as a part of the project.

Implementation of Mitigation Measure 13 would mitigate this impact, but not to a less-than-significant level. Implementation of this measure would allow development only in those areas where damage in the event of the 100-year flood would be less than 50 percent.

13. *Prohibit development in those areas shown to be subject to flood depths of greater than three feet in the event of the 100-year flood, as shown on USCOE working maps, unless that development can comply with FEMA requirements for development in an AE flood hazard zone.*

Depth damage curves used for impact analysis show that damage is 50

Flood Protection with Additional Upstream Storage and Levee Improvement

Natomas

- ⌘ **The 100-year flood could result in approximately 690 million dollars in property damage to new development in Natomas as a result of the project, each year after 1997 that flood protection measures providing 100-year flood protection are not implemented (see Table 11). There is a 1 percent chance of this occurring in any given year. This is a *significant impact*.**

The above impact discussion is based on estimated impacts of the 100-year flood. In Natomas, however, the USCOE has estimated that the level of flood protection with stabilization is as little as 50 years. There is a 2 percent chance of this occurring in any given year.

The impacts associated with the 50-year flood would likely be less than, but not greater than, those for the 100-year flood described above.

Remaining Flood Plain Area

- ⌘ **In a 100-year flood could result in approximately 523 million dollars in property damage to new development as a result of the project each year after 1997 that flood protection measures providing 100-year protection are not implemented (see Table 11). There is a 1 percent chance of this occurring in any given year. This is a *significant impact*.**

The above impact discussion is based on estimated impacts of the 100-year flood. In the remaining flood plain area, however, the USCOE has estimated that the existing level of flood protection is as little as 63 years. There is a 1.6 percent chance of this occurring in any given year.

The impacts associated with the 63-year flood would likely be less than, but not greater than, those for the 100-year flood described above.

Mitigation Measures

Implementation of Mitigation Measure 14 would mitigate this impact to a less-than-significant level, as no development subject to damage in a 100-year flood would be constructed.

14. *Until 100-year flood protection is provided, prohibit development in those areas shown to be subject to the 100-year flood on USCOE working maps, unless that development can comply with FEMA requirements for development in an AE flood hazard zone.*

Implementation of Mitigation Measure 15 would mitigate this impact, but not to a less-than-significant level, as 100-year flood protection measures would not be feasible on a project basis for all areas or all types of development.

15. *Until 100-year flood protection is provided, require flood protection measures for each project as a condition of development.*

Some developments could be protected by levees around the development itself or other flood protection measures constructed as a part of the project.

Provision of flood control measures on a project-by-project basis over the long term could interfere with the comprehensive flood plain control effort.

Implementation of Mitigation Measure 16 would mitigate this impact, but not to a less-than-significant level. Implementation of this measure would allow development only in those area where damage in the event of the 100-year flood would be less than 50 percent.

16. *Until 100-year flood protection is provided, prohibit development in those areas shown to be subject to flood depths of greater than three feet in the event of the 100-year flood, as shown on USCOE working maps, unless that development can comply with FEMA requirements for development in an AE flood hazard zone.*

Depth damage curves used for impact analysis show that damage is 50 percent and greater when flood depths reach levels over three feet.

Impacts of Flooding on Loss of Life

Introduction

As growth takes place in areas subject to flooding, a larger population could potentially be exposed to the risk associated with a 100-year flood.

Methodology

The loss of life calculations were performed assuming a worst case scenario. A worst case scenario would occur early in the morning, when the residential population is at home asleep, and is less likely to receive verbal or broadcasted flood evacuation warnings. It is easier to receive evacuation warnings during working hours because there are more centralized population clusters (Anderson, personal communication, 1989).

To calculate the potential loss of life due to the risk associated with a 100-year flood event the following assumptions were made.

Average Flood Depth

Average flood depth was generalized for each subarea based on information received from the USCOE (Sibilsky and Yarwood, 1989); "Imminent/Actual Flooding Conditions (Levee Overtopping/Failure) Natomas Area" (City of Sacramento); "Summary Report, Time Inundation Study Pocket Area" (City of Sacramento); and elevation and floodflow levels off the 1989 USCOE Working Maps.

Warning Time

Warning time was estimated based on, "Imminent/Actual Flooding Conditions (Levee Overtopping/Failure) Natomas Area" (City of Sacramento); "Summary Report, Time Inundation Study Pocket Area" (City of Sacramento); USCOE flooding scenario information (Sibilsky and Yarwood, 1989); and "American River Watershed Investigation, California Reconnaissance Report" (USCOE).

It was assumed that under existing conditions, given the risk of a sudden levee break along the Sacramento River during a 100-year event, Natomas and the Pocket Area would have a relatively short warning time prior to inundation (less than one hour). However, for the rest of the flood plain, due to the risk of levee overtopping during a 100-year event, it has been assumed that there would be a relatively long warning time of 2 to 6 hours prior to inundation.

With levee stabilization it was assumed that Natomas and the Pocket Area would have a relatively long warning time due to the reduced risk of a sudden levee break along the Sacramento River. The warning time for the rest of the flood plain would remain the same.

With additional upstream storage and levee improvements it was assumed that 100-year protection would be achieved for the 100-year flood plain.

Loss of Life Ratios

After generalizing flooding depth, type of levee failure and flood inundation warning time for each of the subareas, it was assumed that the effects of flooding on potential loss of life would be greater in Natomas and the Pocket Area than in the rest of the flood plain. For this reason the impacts for Natomas and the Pocket Area were discussed separately, but impacts in the rest of the study area were discussed in the aggregate.

The ratios applied to calculate potential loss of life were obtained from the USCOE's "American River Watershed Investigation, California Reconnaissance Report". The USCOE estimated that assuming a relatively long warning time, 2 to 6 hours, "under existing conditions, a major event affecting all the flood plain such as a 200-year event, could potentially cause about 30 fatalities." Therefore, based on 1985 population data for the 200-year flood plain, and assuming that Campus Commons,

South Sacramento, and Downtown would have a relatively long warning time, 30 fatalities could occur out of 303,000 people. This is a ratio of 1 death in 10,100 people.

The USCOE estimated that, "under existing conditions...assuming a short warning time (less than about an hour), and considering the potential depth of flooding, it is estimated that over 100 people could conceivably lose their lives in Natomas due to a levee failure." Furthermore, based on the 1985 population within the 200-year flood plain, and assuming that Natomas would have a relatively short warning time, 100 fatalities could occur out of 22,000 people. This is a ratio of 1 death in 220 people.

These estimates for potential loss of life developed by the USCOE are being reevaluated as part of current USCOE studies. The ratios derived are being used for this study because they represent the only available loss of life calculations performed for the Sacramento Area.

The potential loss of life ratios were applied to the 100-year flood plain population projections derived for Natomas, the Pocket Area and the rest of the flood plain to determine potential fatalities (see Table 12).

Impacts and Mitigation Measures

Existing Level of Flood Protection

Natomas

- ✱ **In Natomas the 100-year flood could result in approximately 17 fatalities from the population projected in the period from 1989 to 1992 as a result of the project (see Table 13). There is a 1 percent chance of this occurring in any given year. It can also be estimated that there is a 3.9 percent change of the 100-year flood event occurring during this four-year period. This is a *significant impact*.**

The above impact discussion is based on estimated impacts of the 100-year flood. In Natomas, however, the USCOE has estimated that the existing level of flood protection is as little as 40 years. There is a 2.5 percent chance of this occurring in any given year. It can be estimated that there is a 9.6 percent chance of the 40-year flood event occurring during this four-year period.

The impacts associated with the 40-year flood would likely be less than, but not greater than, those for the 100-year flood described above.

TABLE 12
POTENTIAL LOSS OF LIFE RATIOS
 (in deaths per a given population)

| | Existing 1989-1992 | 1992-1997 Stabilization | 1997 Additional Upstream Storage and Levee Improvements |
|-------------------------------|-----------------------|----------------------------|--|
| Natomas | 1/220 | 1/10,100 | 1/10,100 |
| The Pocket Area | 1/220 | 1/10,100 | 1/10,100 |
| Remaining Flood Plain Area | 1/10,100 | 1/10,100 | 1/10,100 |

SOURCE: USCOE and EIP Associates, 1989

TABLE 13

NUMBER OF POTENTIAL FATALITIES IN THE 100-YEAR FLOOD PLAIN
UNDER THE THREE FLOOD SCENARIOS

| | 1989 to 1992 Existing Level of Flood Protection | 1992 to 1997 Flood Protection with Stabilization | 1997 Flood Protection with Additional Upstream Storage & Levee Improvements | 1997 to 2010 Annual Increment ¹ |
|-------------------------------|--|---|---|--|
| Natomas | 17 | .37 | 4 | .51 |
| The Pocket Area | 10 | .12 | 4 | .0003 |
| Remaining Flood Plain Area | <u>2</u> | <u>2</u> | <u>34</u> | <u>.47</u> |
| TOTAL | 29 | 2.5 | 42 | 1 |

¹ The annual increment is the additional number of fatalities each year after 1997 that additional upstream storage and levee improvement projects are not implemented.

SOURCE: USCOE and EIP Associates.

The Pocket Area

- ✱ In the Pocket area the 100-year flood could result in approximately 10 fatalities from the population projected in the period from 1989 to 1992 as a result of the project (see Table 13). There is a 1 percent chance of this occurring in any given year. It can also be estimated that there is a 3.9 percent chance of the 100-year flood event occurring during this four-year period. This is a *significant impact*.

The above impact discussion is based on estimated impacts of the 100-year flood. In the Pocket Area, however, the USCOE has estimated that the existing level of flood protection is as little as 63 years. There is a 1.6 percent chance of this occurring in any given year. It can be estimated that there is a 6.2 percent chance of the 63-year flood event occurring during this four-year period.

The impacts associated with the 63-year flood would likely be less than, but not greater than, those for the 100-year flood described above.

Remaining Flood Plain Area

- ✱ In the remaining flood plain area the 100-year flood could result in approximately two fatalities from the population projected in the period from 1989 to 1992 as a result of the project (see Table 13). There is a 1 percent chance of this occurring in any given year. It can also be estimated that there is a 3.9 percent chance of the 100-year flood event occurring during this four-year period. This is a *significant impact*.

The above impact discussion is based on estimated impacts of the 100-year flood. In the remaining flood plain area, however, the USCOE has estimated that the existing level of flood protection is as little as 63 years. There is a 1.6 percent chance of this occurring in any given year. It can be estimated that there is a 6.2 percent chance of the 63-year flood event occurring during this four-year period.

The impacts associated with the 63-year flood would likely be less than, but not greater than, those for the 100-year flood described above.

Mitigation Measures

Implementation of Mitigation Measure 17 would mitigate these impacts to a less-than-significant level, as no additional population subject to risk in a 100-year flood would reside in the 100-year flood plain.

17. *Prohibit development in those areas shown to be subject to the 100-year flood on USCOE May 1989 working maps, unless that development can comply with FEMA requirements for development, in an AE flood hazard zone.*

FEMA requirements include raising the building of residential structures to one foot above the level of the 100-year flood plain. Section 5.2 sets forth specific requirements of the National Flood Insurance Program for the AE flood hazard zone.

Implementation of Mitigation Measure 18 would mitigate these impacts, but not to a less-than-significant level. Implementation of this measure would allow development in the flood plain only in areas where flood warning times would be greater than two hours, and could reduce the potential number of fatalities during a 100-year event.

18. *Prohibit development in those areas where flood inundation time is less than two hours.*

According to the USCOE American River Watershed Investigation Reconnaissance Report, two to six hours is considered a relatively long warning time providing for adequate evacuation.

Implementation of Mitigation Measure 19 would mitigate these impacts, but not to a less-than-significant level. Implementation of this measure could increase the warning time for evacuation, thus potentially decreasing the potential number of fatalities during a 100-year event.

19. *Implement upstream storage and levee improvement projects prior to 1997.*

For each year that 100-year flood protection is achieved the number of fatalities could be reduced. The temporary reoperation of Folsom Dam could be potentially implemented prior to 1997 according to the USCOE.

Implementation of Mitigation Measure 20 would mitigate these impacts, but not to a less-than-significant level. Implementation of this measure could increase the warning time for evacuation, thus decreasing the potential number of fatalities during a 100-year flood.

20. *Implement flood fighting procedures at first warning of the onset of a flood event.*

Such procedures include emergency levee repair (i.e., sandbagging, placement of drain pipes and fill material), and the operation of strategically located flood gates. Flood fighting can be a measure to potentially slow the levee failure process and help hold back flood waters.

Implementation of Mitigation Measure 21 would mitigate these impacts, but not to a less-than-significant level. Implementation of this measure could decrease the evacuation time, thus decreasing the number of potential fatalities during a 100-year flood.

21. *Implement public flood awareness programs to explain the risk associated*

21. *Implement public flood awareness programs to explain the risk associated with a flood event.*

Public flood awareness programs implemented by such agencies as the Office of Emergency Services, and City and County emergency planning departments may help to educate a certain percentage of the population within the study area as to risks associated with flooding, and the importance of speedy evacuation.

Implementation of Mitigation Measure 22 would mitigate these impacts, but not to a less-than-significant level. Implementation of this measure could increase the warning time and could decrease the evacuation time, thus decreasing the potential number of fatalities during a 100-year event.

22. *Expedient implementation of the City of Sacramento's Multi-Hazard Emergency Plan and Sacramento County's Multi-Functional Plan.*

The multihazard plans contain general information on type of flood event (i.e., river flood-slow rise (overtopping) or flash (levee break)); how the river stages are determined; public works flood hazard maps for specified areas; and areas of probable minimum and maximum flooding. The plans contain management guidelines on how the various City/County agencies interact during a flood event.

Implementation of Mitigation Measure 23 would mitigate these impacts to an extent, but not to a less-than-significant level. Implementation of this measure could increase the flood warning time, thus decreasing the potential number of fatalities during a 100-year flood.

23. *Implement the four-stage river warning system.*

The City of Sacramento has implemented a four-stage river warning system as a flood advisory system (see Appendix F).

Flood Protection with Levee Stabilization

Natomas

- ⌘ **In Natomas the 100-year flood could result in approximately .37 fatalities to population projected in the period from 1992 to 1997 as a result of the project (see Table 13). There is a 1 percent chance of this occurring in any given year. In other words, it can be estimated that there is a 4.9 percent chance of the 100-year event occurring during this five-year period, and a 8.6 percent chance of the 100-year event occurring during the nine-year period from 1989 to 1997. This is a *significant impact*.**

The above impact discussion is based on estimated impacts of the 100-year flood. In Natomas, however, the USCOE has estimated that the level of flood protection with stabilization is as little as 50 years. There is a two percent chance of this occurring in any given year. It can be estimated that there is a 9.6 percent chance of the 50-year

flood event occurring during this five-year period. In combination with exposure to the 40-year event during the 1989 to 1992 period, it can be estimated that there would be a 19.2 percent chance of a flood event occurring during the nine-year period from 1989 to 1997.

The impacts associated with the 50-year flood would likely be less than but not greater than those for the 100-year flood described above.

The Pocket Area

- ✱ **In the Pocket Area the 100-year flood could result in approximately .12 fatalities to population projected in the period from 1992 to 1997 as a result of the project (see Table 13). There is a 1 percent chance of this occurring in any given year. It can also be estimated that there is a 4.9 percent chance of the 100-year event occurring during this five-year period, and a 8.6 percent chance of the 100-year event occurring during the nine-year period from 1989 to 1997. This is a *significant impact*.**

The above impact discussion is based on estimated impacts of the 100-year flood. In the Pocket Area, however, the USCOE has estimated that the level of flood protection with stabilization is as little as 63 years. There is a 1.6 percent chance of this occurring in any given year. It can be estimated that there is a 7.7 percent chance of the 63-year flood event occurring during this five-year period, and a 13.4 percent chance of the 63-year event occurring during the nine-year period from 1989 to 1997.

The impacts associated with the 63-year flood would likely be less than, but not greater than, those for the 100-year flood described above.

Remaining Flood Plain Area

- ✱ **In the remaining flood plain area the 100-year flood could result in approximately two fatalities out of the population projected in the period from 1992 to 1997 as a result of the project (see Table 13). There is a 1 percent chance of this occurring in any given year. It can also be estimated that there is a 4.9 percent chance of the 100-year event occurring during this five-year period, and a 8.6 percent chance of the 100-year event occurring during the nine-year period from 1989 to 1997. This is a *significant impact*.**

The above impact discussion is based on estimated impacts of the 100-year flood. In the remaining flood plain area, however, the USCOE has estimated that the level of flood protection with stabilization is as little 63 years. There is a 1.6 percent chance of this occurring in any given year. It can be estimated that there is a 7.7 percent chance of the 63-year flood event occurring during this five-year period, and a 13.4 percent chance of the 63-year event occurring during the nine-year period from 1989 to 1997.

The impacts associated with the 63-year flood would likely be less than but not greater than those for the 100-year flood described above.

Mitigation Measures

24. Please refer to Mitigation Measures 17 to 23 for mitigation measures for these impacts.

Flood Protection with Additional Upstream Storage and Levee Improvement

Natomas

- ✱ **In Natomas, the 100-year flood could result in approximately .51 fatalities per year out of the population as a result of the project, for each year after 1997 that flood protection measures providing 100-year protection are not implemented (see Table 13). There is a 1 percent chance of this occurring in any given year. This is a *significant impact*.**

The above impact discussion is based on estimated impacts of the 100-year flood. In Natomas, however, the USCOE has estimated that the level of flood protection with stabilization is as little as 50 years. There is a 2 percent chance of this occurring in any given year.

The impacts associated with the 50-year flood would likely be less than, but not greater than, those for the 100-year flood described above.

The Pocket Area

- ✱ **In the Pocket Area the 100-year flood could result in approximately .003 fatalities per year out of the population as a result of the project, for each year after 1997 that flood protection measures providing 100-year protection are not implemented (see Table 13). There is a 1 percent chance of this occurring in any given year. This is a *significant impact*.**

The above impact discussion is based on estimated impacts of the 100-year flood. In the Pocket Area, however, the USCOE has estimated that the existing level of flood protection is as little as 63 years. There is a 1.6 percent chance of this occurring in any given year.

The impacts associated with the 63-year flood would likely be less than, but not greater than, those for the 100-year flood described above.

Remaining Flood Plain Area

- ✱ **In the remaining flood plain area the 100-year flood could result in approximately .47 fatalities per year out of the population as a result of the project, for each year after 1997 that flood protection measures providing 100-year protection are not implemented (see Table 13). There is a 1 percent chance of this occurring in any given year. This is a *significant impact*.**

The above impact discussion is based on estimated impacts of the 100-year flood. In the remaining flood plain area, however, the USCOE has estimated that the existing level of flood protection is as little as 63 years. There is a 1.6 percent chance of this occurring in any given year.

The impacts associated with the 63-year flood would likely be less than, but not greater than, those for the 100-year flood described above.

Mitigation Measures

25. Please refer to Mitigation Measures 17 to 23 for mitigation measures for these impacts.

6. OTHER STATUTORILY REQUIRED SECTIONS

6.1 CUMULATIVE IMPACTS

In the context of this analysis, cumulative impacts relate to the contribution of the Proposed Land Use Policy to the total risk associated with all development in the 100-year flood plain. Total cumulative impacts are defined as the risks of flooding to existing and projected development. The project's contribution is the proportion of the total risk which would be due to development allowed by the Proposed Land Use Policy.

Cumulative Impacts of Flooding on Potential Property Damage

Introduction

The project could contribute to the cumulative impact of flooding on property damage. A significant impact would occur if impacts due to the project add to impacts due to existing conditions.

Methodology

The methodology used to estimate potential property damage is described in Section 5.4, page 101.

Impacts and Mitigations

Natomas

Impacts

- ⌘ In 1992, the 100-year flood could result in approximately 4.1 billion dollars in property damage in Natomas to existing plus new development that had occurred in the period from 1989 to 1992 as a result of the project (see Table 14). There is a 1 percent chance of this occurring in any given year. There is also a 3.9 percent chance of the 100-year flood occurring during this four year period. This is a *significant cumulative impact*.

The project would contribute approximately 12 percent of this cumulative impact (see Table 14).

- ⌘ In 1997, the 100-year flood could result in approximately 4.4 billion dollars in property damage in Natomas to existing plus new development that had occurred in the period from 1989 to 1997 as a result of the project (see Table 14). There is a 1 percent chance of this occurring in any given year. There is also an 8.6 percent chance of the 100-year flood occurring during this nine year period. This is a *significant cumulative impact*.

TABLE 14
POTENTIAL PROPERTY DAMAGE CUMULATIVE IMPACTS (BILLIONS OF DOLLARS)
AND PERCENT CONTRIBUTION OF PROJECT TO CUMULATIVE IMPACTS

| | 1992 | 1989-1992 Project Increment | Percent Contribution Project | 1997 | 1989-1997 Project Increment | Percent Contribution Project | Annual Increment After 1997 |
|--|------|-----------------------------------|------------------------------------|------|-----------------------------------|------------------------------------|-----------------------------------|
| Natomas | 4.1 | .501 | 12% | 4.4 | .805 | 18% | .7 |
| Remaining Flood Plain Area ¹ | 33.5 | 3.1 | 9.3% | 36.2 | 6 | 17% | .04 |

¹ Includes the Pocket Area

SOURCE: EIP Associates, 1989.

The project would contribute 18 percent of this cumulative impact (see Table 14).

- ⌘ **Flood damage to property in Natomas in dollars would be approximately 3 percent greater each year after 1997 that 100-year protection is not provided. There is a 1 percent chance of this occurring in any given year. This is a *significant impact*.**

Remaining Flood Plain Area

- ⌘ **In 1992, the 100-year flood could result in a total of approximately 37.7 billion dollars in property damage in the remaining flood plain area to existing plus new development that had occurred in the period from 1989 to 1992 as a result of the project (see Table 14). There is a 1 percent chance of this occurring in any given year. There is also a 3.9 percent chance of a 100-year flood occurring during this four-year period. This is a *significant cumulative impact*.**

The project would contribute approximately 9.3 percent of this cumulative impact (see Table 14).

- ⌘ **In 1997, the 100-year flood could result in approximately 40.8 billion dollars in property damage in the remaining flood plain area to existing plus new development that had occurred in the period from 1989 to 1997 as a result of the project (see Table 14). There is a 1 percent chance of this occurring in any given year. There is also an 8.6 percent chance of the 100-year flood occurring during this nine year period. This is a *significant cumulative impact*.**

The project would contribute approximately 17 percent of this cumulative impact (see Table 14).

- ⌘ **Flood damage to property in the remaining flood plain area in dollars would be approximately 3 percent greater each year after 1997 that 100-year flood protection is not provided. There is a 1 percent chance of the 100-year flood occurring in any given year. This is a *significant impact*.**

Mitigation Measures

Implementation of Mitigation Measures 11 through 16 for project impacts would mitigate the project's contribution to cumulative impacts as described in Section 5-4. There is, however, no adequate mitigation for cumulative impacts. Impacts of the flooding due to a 100-year event on existing development in areas subject to 100-year flood protection could be mitigated only by increased flood protection, which would result in these areas no longer being subject to the 100-year flood.

TABLE 15
POTENTIAL LOSS OF LIFE CUMULATIVE IMPACTS (NUMBER OF FATALITIES)
AND PERCENT CONTRIBUTION OF PROJECT TO CUMULATIVE IMPACTS

| | 1992 | 1989-1992 Project Increment | Percent Contribution Project | 1997 | 1989-1997 Project Increment | Percent Contribution Project | Annual Increment After 1997 |
|-------------------------------|------|-----------------------------------|------------------------------------|------|-----------------------------------|------------------------------------|-----------------------------------|
| Natomas | 155 | .4 | 11% | 4 | .76 | 20% | .51 |
| The Pocket Area | 193 | .2 | 5.2% | 4 | .3 | 7.9% | .003 |
| Remaining Flood Plain Area | 31 | 2 | 6.5% | 34 | 4 | 12% | .47 |

SOURCE: EIP Associates, 1989.

Mitigation Measure 24 would reduce the amount of time existing development would be exposed to the risk of flooding due to the 100-year flood, but would not mitigate cumulative impacts to a less-than-significant level.

24. *Provide 100-year flood protection for all areas in the study area before 1992.*

Cumulative Impacts of Flooding on Potential Loss of Life

Introduction

The project could contribute to the cumulative impact of flooding on loss of life. A significant impact would occur if impacts due to the project add to impacts due to existing conditions.

Methodology

The methodology used to estimate the potential loss of life is described in Section 5.4, pages 106 to 108.

Impacts and Mitigation

Natomas

Impacts

- ⌘ In 1992, the 100-year flood could result in a total of approximately 155 fatalities in Natomas based on existing population in the flood plain area plus new population that could occur in the period from 1989 to 1992 as a result of the project (see Table 15). There is a 1 percent chance of this occurring in any given year. It can also be estimated that there is a 3.9 percent chance of the 100-year flood occurring during this four-year period. *This is a significant cumulative impact.*

The project would contribute approximately 11 percent of this cumulative impact (see Table 15).

- ⌘ In 1997, the 100-year flood could result in a total of approximately four fatalities in Natomas based on existing population in the flood plain area plus new population that could occur in the period from 1989 to 1997 as a result of the project (see Table 15). There is a 1 percent chance of this occurring in the given year. It can also be estimated that there is an 8.6 percent chance of the 100-year flood occurring during this nine year period. *This is a significant impact.*

The project would contribute approximately 20 percent of this cumulative

The project would contribute approximately 20 percent of this cumulative impact (see Table 15).

- ⌘ For each year after 1997 in which 100-year protection is not obtained, the 100 year flood would result in approximately .51 fatalities annually in Natomas as a result of the project (see Table 15). There is a 1 percent chance of this occurring in any given year after 1997. This is a *significant impact*.

The Pocket Area

Impacts

- ⌘ In 1992, the 100-year flood could result in a total of approximately 193 fatalities in the Pocket Area based on existing population in the flood plain area plus new population that could occur in the period from 1989 to 1992 as a result of the project (see Table 15). There is a 1 percent chance of this occurring any given year. There is also a 3.9 percent chance of the 100-year flood occurring in this four-year period. This is a *significant cumulative impact*.

The project would contribute approximately 5.2 percent of this cumulative impact (see Table 15).

- ⌘ In 1997, the 100-year flood could result in a total of approximately four fatalities in the Pocket Area based on existing population in the flood plain area plus new population that could occur in the period from 1989 to 1997 as a result of the project (see Table 15). There is a 1 percent chance of this occurring any given year. There is also an 8.6 percent chance of the 100-year flood occurring during this nine-year period. This is a *significant cumulative impact*.

The project would contribute approximately 7.9 percent of this cumulative impact (see Table 15).

- ⌘ For each year after 1997 in which 100-year flood protection is not obtained, the 100-year flood would result is approximately .0003 fatalities annually in the Pocket Area as a result of the project (see Table 15). There is a 1 percent chance of this occurring any given year after 1997. This would be a *less-than-significant cumulative impact*.

Remaining Flood Plain Area

Impacts

- ✱ In 1992, the 100-year flood could result in a total of approximately 30 fatalities in the remaining flood plain area based on existing population in the flood plain area plus new population that could occur in the period from 1989 to 1992 as a result of the project (see Table 15). There is a 1 percent chance of this occurring in any given year. There is also a 3.9 percent chance of a 100-year flood occurring in this four-year period. This is a *significant cumulative impact*.

The project would contribute approximately 6.5 percent of this cumulative impact (see Table 15).

- ✱ In 1997, the 100-year flood could result in a total of approximately 34 fatalities in the remaining flood plain area based on existing population in the flood plain area plus new population that could occur in the 1989 to 1997 period as a result of the project (see Table 15). There would be a 1 percent chance of this occurring in any given year. There is also an 8.6 percent chance of the 100-year occurring in this nine-year period. This is a *significant cumulative impact*.

The project would contribute approximately 12 percent of this cumulative impact (see Table 15).

- ✱ For each year after 1997 in which 100-year protection is not obtained, the 100-year flood would result in approximately .47 fatalities annually in the remaining flood plain area as a result of the project (see Table 15). There is a 1 percent chance of this occurring in any given year after 1997. This is a *significant cumulative impact*.

Mitigation Measures

Implementation of Mitigation Measures 17 through 25 for project impacts would mitigate the project's contribution to cumulative impacts as described in Section 5-4. There is, however, no adequate mitigation for cumulative impacts. Impacts of the flooding due to the 100-year event on existing populations in areas subject to 100-year flood protection could only be mitigated by increasing flood protection, which would result in these areas no longer being subject to the 100-year flood.

Mitigation Measure 26 would reduce the amount of time that existing population would be exposed to the risk of flooding due to the 100-year flood, but would not mitigate cumulative impacts to a less-than-significant level.

26. *Provide 100-year flood protection for all areas in the 100-year flood plain prior to 1992.*

6.2 GROWTH INDUCEMENT

Section 15126(g) of the CEQA Guidelines requires a discussion of the ways in which the proposed project could be growth-inducing, e.g. promote economic or population growth or the construction of new housing. "Induced" growth under this section of CEQA includes the direct employment, population, or housing growth of a project as well as the secondary or indirect growth accompanying direct growth. New employees from commercial development and new population from residential development represent direct growth and induce additional economic activity in a given area from the increase in aggregate spending (demand) they cause. New employment that generates development further increases economic activity in an area because of increasing purchasing of services and goods. New employment also escalates the demand for local housing, although by less than the proportional increase in employment. A project could also induce growth by lowering or removing infrastructural barriers to growth, improving transportation access to an area, or by creating an amenity such as a recreational facility that attracts new population or economic activity.

Typically, the growth-inducing potential of a project or action would have a significant growth-inducing impact if it either fostered growth or created capacity to accommodate growth above and beyond what was permitted by the appropriate General Plans or contained in growth projections of independent regional planning agencies. However, the creation of growth-inducing potential does not automatically lead to growth, whether it would be below or above projected levels. Growth at the local level is fundamentally controlled by the land use policies of local municipalities or counties. These in turn are influenced by development pressures and the local politics of growth. The sum of influences is a local jurisdiction's growth management posture and policy. The growth-inducing potential or pressure created by a project is therefore mediated by the locality itself.

The proposed policy does not meet the standards for growth inducement described above. The policy would allow development to continue at essentially the same pace as is currently, and has been, anticipated for development throughout the flood plain area. In fact, the policy places stringent restrictions on additional development beyond that envisioned in the General Plan documents and in projections by SACOG by limiting the ability of the City or County to increase the level of urbanization beyond that currently planned for.

6.3 SIGNIFICANT UNAVOIDABLE ADVERSE IMPACTS WHICH COULD NOT BE AVOIDED IF THE PROJECT IS IMPLEMENTED

This chapter identifies impacts that could not be eliminated or reduced to a less-than-significant level by mitigation measures included as part of the project or other mitigation measures that could be implemented. The final determination of the significant impacts will be made by the City Council as part of their certification action.

The following significant unavoidable adverse impacts resulting from the proposed policy have been identified:

There are essentially no significant loss of life and property damage impacts which could be avoided if the proposed policy is implemented.

The only mitigation measure would be to adopt a land use policy which prohibits additional development until 100-year flood protection is achieved.

6.4 RELATIONSHIP BETWEEN THE LOCAL SHORT-TERM USES OF THE ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

Implementation of the proposed policy would allow the permanent urbanization of large amounts of land which are currently vacant, underutilized and agricultural lands as planned for in the City and County of Sacramento General Plans. The policy would, however, protect unplanned agricultural lands from urbanization for a period of at least four years. Short-term risks to life and property would be increased by development which would occur under the policy.

The policy, by allowing development to continue in the flood plain, would limit the region's options for addressing flood protection in the future by expanding the amount of development which would require protection. It should be noted, though, that large areas of the City and County currently developed are located within the area of the flood plain. The need to provide additional flood protection exists currently and would only be exacerbated by additional development in the future.

The Sacramento Metropolitan Flood Protection Task Force, in proposing the policy, believes that additional development which would occur in the flood plain is necessary in order to generate funds for required local contributions to costly flood protection efforts. One long-term implication of substantial restrictions on development in the flood plain could be that lack of funding eliminates or defers the provision of 100-year flood protection to existing development in the City and County.

6.5 SIGNIFICANT IRREVERSIBLE ENVIRONMENTAL CHANGES WHICH WOULD BE INVOLVED IN THE PROPOSED ACTION SHOULD IT BE IMPLEMENTED

Implementation of the proposed policy would entail the commitment of natural, energy and human resources. This commitment would be a long-term obligation since it is difficult to envision circumstances that would justify the return of the land to its original condition once it has been developed. The resource commitment produced by implementation of the policy would occur mainly as a result of alterations of the physical environment in the form of infrastructure and more intensive land use. This would increase the community's productivity in terms of land use efficiency. However, project implementation would also contribute incrementally to the permanent loss of open space and agricultural lands.

A transformation of a portion of the 100-year flood plain from open space or agricultural land to urban uses is an irreversible commitment of the land. After the structural lifespan of the buildings are reached, it would be theoretically possible to redevelop the area to an alternative land use or uses; however, it is extremely unlikely that any developed portion of the 100-year flood plain would be returned to its current agricultural or open space use. The potential for such a reversion of the flood plain area becomes highly unlikely due to the large capital investment that would have already been committed. Loss of undeveloped lands in the flood plain constitutes an irreversible and irretrievable commitment of the flood plain area.

Implementation of the policy would allow development which would result in a long-term, irreversible commitment of energy resources, primarily in the form of fossil fuels, including fuel oil, natural gas, and gasoline for automobiles and construction equipment. The consumption or destruction of other non-renewable and slowly-renewable resources would also result during construction and operation of the proposed development. These resources include, but are not limited to: lumber, sand and gravel, asphalt, metals, water, etc.

7. ALTERNATIVES

7. ALTERNATIVES

This chapter consists of possible alternatives to the Proposed Land Use Policy. For each alternative, the environmental impacts of the alternative as well as the environmental impacts of the Proposed Land Use Policy to be avoided are identified. Additional information regarding how the alternative meets, or does not meet, the City's and County's objectives described in Chapter 3, Project Description, is also included. The City Planning Commission and the County Board of Supervisors could approve an alternative project if they determine that the alternative represents a more appropriate policy.

The following three alternatives are considered:

- ✧ Alternative One: No Project (required by CEQA);
- ✧ Alternative Two: Application of the Existing Flood Plain Management Regulations Based on the January 1989 Working Maps;
- ✧ Alternative Three: Application of the Proposed Land Use Policy to Non-Residential Structures Only and Imposition of Flood Plain Regulations on Residential Structures Based on January 1989 Working Maps.

Alternative One: No Project

Description

Under the No Project Alternative, no action on the part of the City or County would be taken to adopt the Proposed Land Use Policy. Development and planning processes would proceed as they are at the present time.

Impacts

There would be no essential differences between impacts of this alternative and those described for the Proposed Land Use Policy.

There could be several important implications of the No Project Alternative, however. First, the lack of a restriction on annexations and General Plan amendments that increase urbanization could allow development beyond that described for the Proposed Land Use Policy. No new development has been projected for areas beyond those planned for in the General Plans and, thus, the land use projections and risk calculations included in this document do not account for this growth-inducing effect.

Second, the Special Legislation required the local jurisdictions to take action to control growth in areas subject to flooding during the period of the legislation. A lack of action by the City and/or County possibly could result in the Congress revisiting the Special Legislation, with rescission of the legislation an eventual possibility. Rescission of the Special Legislation would probably result in Alternative Two, described below.

Relationship to Project Objectives

The No Project Alternative would be inconsistent with two of the objectives identified in Chapter 3, Project Description, page 3-1. It would be inconsistent with the objective of complying with the intent and spirit of the flood protection provisions of the Special Legislation since it would leave the City and County without a policy for development in the flood plain and would place no restriction on changes of land use resulting in increased urbanization. Related to this, the potential for rescission of the Special Legislation is not consistent with the objective of minimizing potential economic and social disruption of the Sacramento region. Finally, as the risks associated with the No Project Alternative are essentially the same as those for the Proposed Land Use Policy, there would be no difference in how these alternatives relate to the objective of avoiding undue exposure to the risks of floods as described in Chapter 5.4 of this document.

Alternative Two: Application of the Existing Flood Plain Management Regulations Based on January 1989 Working Maps

Description

This alternative would involve the adoption of a policy by the City and the County that would result in the imposition of existing City and County flood plain management regulations based on the January 1989 Working Maps. These maps, independent of the Special Legislation, contain the base flood elevation for all parts of the 100-year flood plain.

With this information the City and County would implement their current flood plain management regulations. In summary, these regulations require the floor of the first occupied level of a residential structure to be one foot above the base flood elevation. Non-residential structures must be designed by a licensed architect or civil engineer, must allow for entry and exit of flood waters without the exertion of extraordinary pressures placed upon the building, and must have water-proofed electrical and sanitary sewer facilities in all areas below the base flood elevation.

Impacts

This alternative would substantially limit the development of residential uses in the flood plain areas. However, it is assumed that standard foundation construction design could raise building pads from one to three feet. Therefore, it is considered likely that residential uses would continue to be developed in areas, such as Florin and Perkins, where sheet flows during a flood would result in water depths of less

than two feet. Non-residential development would most likely proceed at a relatively rapid pace even with this alternative.

There would be several factors that could result in a reduction in the level of non-residential development, including the cost of floodproofing measures required by the City and County flood plain management regulations, a possible slowing of the regional economy tied to the restrictions in residential development elsewhere in the flood plain, and requirements for a balanced relationship between jobs and housing in the Natomas area. The particular effects of the first two factors would depend upon many variables, including trends in local land values, commercial rents, the regional economy including the relative development costs in other parts of the region, and trends in the national economy. This multitude of variables makes it especially speculative to attempt to quantify the degree of restriction on non-residential development which would occur with imposition of the local flood plain management regulations. Therefore, in order to provide for a conservative estimate of potential risk, it is assumed that all non-residential development which would occur outside of Natomas with the project would also occur with Alternative Two. In Natomas, it is assumed that non-residential development would not be allowed independent of associated residential development, consistent with community plan policies for North and South Natomas.

Table 16 describes the projected levels of growth associated with land use development under Alternative Two. In summary, overall growth of residential uses would be restricted to 2,000 units between 1989 and 1997, a decrease of 89 percent over the level of residential growth under the Proposed Land Use Policy. Overall growth of non-residential uses is assumed to be the same as that described for the Proposed Land Use Policy outside of Natomas and no non-residential development would be constructed in Natomas prior to the provision of 100-year flood protection and the onset of residential development.

With Alternative Two, there would be no incremental increase in risk associated with the loss of life. For areas of substantial flood water depth, it is unlikely that the local residential development market could accommodate the site preparation costs necessary to raise development pads one foot above the base flood elevation. Therefore there would be no increase in population at risk in these areas. In Florin and Perkins, where shallow depths make it possible that residential development would proceed, it is assumed that development pads are, in fact, raised above the flood elevation, ensuring that those new residents would not be part of the population at risk.

Under this alternative, non-residential development would be subject to property damage due to flooding. Assuming no non-residential development in Natomas, growth between 1989 and 1997 could be exposed to damages of about 3.2 billion dollars in the event of a worst-case 100-year flood event. This amount of damage would represent a decrease of about 50 percent compared to the property damage impacts associated with the Proposed Land Use Policy.

TABLE 16
IMPACTS OF THE ALTERNATIVES
 (Incremental Increases in Impact Due to Project and Alternatives)
 (Base Year 1988)

| | Population (Thousands) | | | Housing Units (Thousands) | | | Non-Resident Development (Millions) | | | Added Property Damage (in millions) | | | | | | Added Loss of Life | | | | | |
|------------------|---------------------------|------|-------|------------------------------|------|------|---|------|------|-------------------------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|
| | 1992 1997 2010 | | | 1992 1997 2010 | | | 1992 1997 2010 | | | Natomas | | Pocket | | Rest of FP | | Natomas | | Pocket | | Rest of FP | |
| | 1992 | 1997 | 2010 | 1992 | 1997 | 2010 | 1992 | 1997 | 2010 | 1989-92 ^a | 1992-97 ^b | 1989-92 ^a | 1992-97 ^b | 1989-92 ^a | 1992-97 ^b | 1989-92 ^a | 1992-97 ^b | 1989-92 ^a | 1992-97 ^b | 1989-92 ^a | 1992-97 ^b |
| Proposed Project | 26.7 | 28.1 | 128.2 | 11.5 | 6.6 | 66.0 | 14.4 | 16.4 | 58.0 | 501 | 303 | 253 | 177 | 2,845 | 2,334 | 17 | .37 | 10 | .12 | 2 | 2 |
| Alternative 1 | 26.7 | 28.1 | 128.2 | 11.5 | 6.6 | 66.0 | 14.4 | 16.4 | 58.0 | 501 | 303 | 253 | 177 | 2,845 | 2,334 | 17 | .37 | 10 | .12 | 2 | 2 |
| Alternative 2 | 3.0 | 2.0 | 4.0 | 1.3 | 0.7 | 2.5 | 13.3 | 15.7 | 32.3 | 0 | 0 | 83 | 105 | 1,517 | 1,532 | 0 | 0 | 0 | 0 | 0 | 0 |
| Alternative 3 | 3.0 | 2.0 | 4.0 | 1.3 | 0.7 | 2.5 | 14.4 | 16.4 | 58.0 | 164 | 93 | 83 | 105 | 1,517 | 1,532 | 0 | 0 | 0 | 0 | 0 | 0 |

a = Prior to levee stabilization.

b = Prior to attainment of 100-year protection.

Relationship to Project Objectives

This alternative would be inconsistent with two of the objectives identified in Chapter 3, Project Description, page 3-1. Alternative Two would not be consistent with the objective of minimizing the potential disruption of the Sacramento region, since it would place severe restrictions on the vast majority of developable residential land, and since there would be the potential for economic disruption which could affect the non-residential development market. Such economic disruption could take the form of substantial delays, up to a decade, in the development of large expanses of Natomas and other areas of the City and the County. Conversely, those developments that would continue would do so at greater expense in order to meet FEMA requirements, with the potential for effects on the housing price structure in the area's housing market. Finally, as the risks associated with this alternative are substantially less than those for the project, this alternative could be said to more closely meet the objective of avoiding undue exposure to the risks of floods than the Proposed Land Use Policy.

Alternative Three: Application of the Proposed Land Use Policy to Non-Residential Structures Only

Description

This alternative would involve the adoption of a policy by the City and the County that would result in the imposition of the Proposed Land Use Policy to non-residential structures and imposition of the existing City and County Flood Plain management regulations (based on the January 1989 Working Maps) to residential uses. It is further assumed with this alternative that the City Council determines the economic need sufficient to waive the jobs/housing requirements for development in Natomas, allowing non-residential development to proceed independent of residential construction.

Impacts

Like Alternative Two, this alternative would substantially limit the development of residential uses in the flood plain areas. It is likely that residential uses would continue to be constructed in areas, such as Florin and Perkins, where sheet flows during a flood would result in water depths of less than two feet. In these two areas it would be expected that residential developers could raise development pads such that units could conform with local flood plain regulations. Again, like Alternative Two, it would be expected that non-residential development would in all likelihood proceed at an unhindered rapid pace with this alternative.

There would be two factors which could result in a reduction in the level of non-residential development, including the cost of floodproofing measures required by the City and County flood plain management regulations and a possible slowing of the regional economy tied to the restrictions in residential development elsewhere in the flood plain. The overall effect on development of these two factors would depend upon many variables, including trends in local land values, commercial rents,

the regional economy, including the relative development costs in other parts of the region, and trends in the national economy. This multitude of variables makes it especially speculative to attempt to quantify the degree of restriction on non-residential development which would occur with imposition of the local flood plain management regulations. Therefore, in order to provide for a conservative estimate of potential risk, it is assumed that all non-residential development which would occur with the Proposed Land Use Policy would also occur with Alternative Three.

Table 16 on page 7-3 describes the projected levels of growth associated with land use development under Alternative Three. In summary, overall growth of residential uses would be restricted to about 2,000 units, a decrease of 89 percent over the level of residential growth under the proposed policy. Overall growth of non-residential uses is assumed to be the same as that described for the Proposed Land Use Policy.

With Alternative Three, as with Alternative Two, there would be no incremental increase in risk associated with the loss of life. For areas of substantial flood water depth, it is unlikely that the local residential development market could accommodate the site preparation costs necessary to raise development pads one foot above the base flood elevation. Therefore there would be no increase in population at risk in these areas. In Florin and Perkins, where shallow depths make it possible that residential development would proceed, it is assumed that development pads are, in fact, raised above the flood elevation, ensuring that those new residents would not be part of the population at risk.

Under this alternative, the same amount of non-residential development would be subject to property damage due to flooding as with the Proposed Land Use Policy. Residential development would not be added in locations where flood damage from the 100-year flood would occur. Non-residential development alone, constructed between 1989 and 1997, could be exposed to damages of about 3.5 billion dollars in the event of the worst-case 100-year flood event. This amount of damage would represent a decrease of about 45 percent compared to the property damage impacts associated with the Proposed Land Use Policy.

Relationship to Project Objectives

This alternative would be inconsistent with two of the objectives identified in Chapter 3, Project Description, page 3-1. Alternative Three would not be consistent with the objective of minimizing the potential disruption of the Sacramento region, since it would place severe restrictions on the vast majority of developable residential land. However, this alternative would likely decrease the potential economic disruption associated with restriction on development in the flood plain due to the allowance for non-residential development throughout the City and County areas of the flood plain. Finally, as the risks associated with this alternative are substantially less than those for the Proposed Land Use Policy, this alternative could be said to more closely meet the objective of avoiding undue exposure to the risks of floods than the proposed policy. However, the risk of property damage is somewhat higher with this alternative than with Alternative Two.

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11. APPENDICES

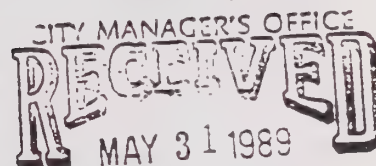
APPENDIX A
PROPOSED LAND USE POLICY

SACRAMENTO FLOOD CONTROL PLANNING

25A

SACRAMENTO
METROPOLITAN
FLOOD PROTECTION
TASK FORCE

June 7, 1989



SACRAMENTO COUNTY

Grantland Johnson
Sandra Smoley

City Council
Sacramento, CA

Honorable Members in Session:

SACRAMENTO CITY

Anne Rudin
Lynn Robie

SUBJECT: LAND USE PLANNING POLICY WITHIN 100 YEAR FLOOD
PLAIN

RECLAMATION DISTRICT
1000

Bill Christopher
Manuel Barandas

AMERICAN RIVER FLOOD
CONTROL DISTRICT

James R. Nickless
Teinkamp

SUMMARY

On April 27, 1989, the Sacramento Metropolitan Flood Protection Task Force recommended approval of the attached land use planning policy and instructed the City Attorney's office to finalize its position on the notification process. This followed nearly two months of discussions with numerous concerned builders, developers and their representatives and with City and County Planning and Legal staffs. The resultant recommended policies are identified in Exhibit A.

DIRECTOR

William H. Edgar

Staff recommends that the planning policy be received and the City's Acting Environmental Coordinator be instructed to take necessary actions to initiate and complete an environmental impact report (EIR) as soon as possible. After the EIR is completed, the City Council may issue appropriate findings as to the environmental impact of the policy and proceed with adoption. The City Attorney will present a separate report concerning the notice, waivers of claims and indemnification as it relates to this policy.

BACKGROUND:

Special legislation passed by Congress and signed by the President in November, 1988 establishes the legal framework within which Sacramento's governmental authorities are authorized to respond to recently updated base flood elevations for the greater Sacramento area. These new flood elevations have been determined by the U.S. Army Corps of Engineers for the Federal Emergency Management Agency (FEMA) and indicate a large portion of

LAND USE PLANNING POLICY

June 7, 1989

Page 2

the City and County lie within a flood plain. The special legislation prohibits FEMA from using these new elevations to impose new flood insurance rates in Sacramento, and permits existing elevations and rates to be continued for up to four years as necessary in order to give Sacramento an opportunity to mount an effective flood control effort. Specifically, the special legislation authorizes the City and County to permit such new development at existing elevations and insurance rates as may be required to preserve the institutional and economic relationships necessary to sustain an effective flood protection effort. In exercising this authority, the City and County are obligated to avoid undue exposure to the dangers of floods and to comply to the maximum extent practicable with FEMA's updated base flood elevations.

In order to participate in the National Flood Insurance Program (NFIP) and thereby mitigate potential losses due to flooding, the City and County must satisfy certain statutorily mandated flood plain management criteria. These criteria, along with the actuarial (risk-based) insurance rates applicable under the NFIP, are established on the basis of flood map elevation determinations made by the Director of FEMA pursuant to the provisions of the National Flood Insurance Act of 1968. Based on studies by the Corps of Engineers, indicating increased vulnerability attributable to increased estimates of the frequency of large storms in the region, FEMA has begun a process of reanalyzing the flood risks in the Sacramento area. This analysis is likely to result in substantially increased flood elevation requirements under the NFIP.

In adopting the 1988 special legislation, Congress has recognized that changed flood elevation requirements attributable to a change in flood elevation determinations by FEMA could cause severe disruption in the Sacramento region and could undermine the community's ability to carry out an effective flood protection effort. To avoid this consequence, the special legislation prohibits FEMA from imposing any new elevation requirements in the Sacramento area for up to four years. This prohibition effectively precludes FEMA from charging actuarial (risk-based) flood insurance rates within the Sacramento area. Accordingly, FEMA has agreed to continue to make flood insurance available at rates normally utilized outside areas of special flood hazard. Because actuarial rates for any permitted new construction in the flood plain would likely be considerably higher than current rates, the special legislation in effect creates a subsidy for such construction.

LAND USE PLANNING POLICY
June 7, 1989
Page 3

In conferring this benefit upon Sacramento area developers, the special legislation expressly obligates the City and County to avoid undue exposure to the dangers of floods and to voluntarily comply with FEMA'S updated base flood elevations to the extent practicable, consistent with the demands of carrying out a comprehensive flood protection effort.

Exhibit A translates these federal mandates into policy recommendations. The following summarizes the significant recommendations:

1. It is recommended that the following policy recommendations and implementation measures be in place until approximately July 1, 1990 and until the City Council and Board of Supervisors determine that the nature of the flood risk is acceptable for their respective jurisdictions. It is anticipated that the construction contract for the levee reconstruction project will be awarded by July 1, 1990 at which time the staff anticipates recommending that the City Council and Board of Supervisors rescind these policies.

Notwithstanding the above, it should be understood that property owners will still be required to sign the appropriate notices and waivers acceptable to the City Attorney and County counsel until FEMA has notified the City and County that the 100 year flood protection has been achieved. In addition, applications for zoning or pre-zoning changes within the flood plain and not consistent with existing City and County Plan from agricultural to urban use will not be approved during the period covered by the special legislation approved by Congress in 1988.

2. It is recommended that the City and County reaffirm their commitment to Congress not to designate any increase in urbanization beyond lands already so designated in the City's General Plan or in the County's pending General Plan update.
3. It is recommended that discretionary entitlements for residential projects that have been filed after April 1, 1989 be processed; however, no building permit shall be approved by the City or County unless it can be shown that the project can be built in accordance with the Corps of Engineers' January, 1989 working maps, and any applicable City and County regulations.
4. It is recommended that discretionary entitlements for residential projects that have been filed by April 1, 1989 be allowed to proceed subject to the owner's signing all legal conditions and waivers developed by the City Attorney's and County Counsel's office prior to recordation of final maps or issuance of building permit.

LAND USE PLANNING POLICY

June 7, 1989

Page 4

5. It is recommended that the City review on a case by case basis requests for entitlements for projects under development agreements.
6. It is recommended that for non-residential buildings, the building be designed to minimize the extent of structural damage sustained in the event of a 100-year flood.
7. It is recommended that for areas not affected by the Sacramento River levee system but within the 100-year flood plain, no building permits will be issued unless all legal conditions and waivers have been executed or it can be shown that the project can be built in accordance with the Corps of Engineers' 1989 working maps and with applicable City and County regulations.

FINANCIAL

The proposed action will maintain existing flood insurance rates for new construction permitted in the flood plain. However, restriction of residential development in the areas affected by the Sacramento River levee system will have certain negative financial and economic impacts throughout the community.

POLICY IMPLICATIONS

The land use planning policy recommendations are intended to be in effect until July 1, 1990, when it is anticipated that the construction contract for the levee reconstruction project will be awarded and at which time the staff anticipates recommending that these policies be rescinded. At that time, the City Council and Board of Supervisors will determine if the flood risk is acceptable for their jurisdictions. The recommendations are not intended to negate or lessen any existing flood control mitigation requirements for the flood plain. Nor is it intended to create additional restrictions or cause undo hardship to any assessment districts or other projects approved by either the City Council or Board of Supervisors.

Notwithstanding the above, it should be understood that property owners will still be required to sign the appropriate notices and waivers acceptable to the City Attorney and County Counsel until FEMA has notified the City and County that the 100 year flood protection has been achieved. In addition, applications for zoning or pre-zoning changes within the flood plain and not consistent with existing City and County Plan from agricultural to urban use will not be approved during the period covered by the special legislation approved by Congress in 1988.

LAND USE PLANNING POLICY
June 7, 1989
Page 5

ENVIRONMENTAL REVIEW

The policy recommendations on new development in the floodplain may result in either a direct or indirect physical change in the environment. They are therefore subject to environmental review prior to adoption by the City Council or Board of Supervisors. It is anticipated that this environmental review will take the form of an environmental impact report which will be completed in approximately six months. At that time, the City Council and Board of Supervisors may issue appropriated findings as to the environmental impact of the policy and proceed with adoption.

It is recommended that the City take the lead in performing the EIR, because the policy has greater impact on areas within the City's boundaries. Therefore, it is recommended that the City's Acting Environmental Coordinator be directed to proceed with actions necessary to complete the EIR within a timely period. A separate report will be prepared by the City's Acting Environmental Coordinator detailing the recommended contractor to complete the EIR, timeframe, costs and funding requirements.

MBE/WBE

Not applicable.

RECOMMENDATION

It is recommended that the City Council receive and file this report and instruct the City's Acting Environmental Coordinator to proceed in completing an environmental impact report.

Respectfully submitted,

Approval Recommended



WILLIAM H. EDGAR
Executive Director



WALTER J. SLUPE
City Manager

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All Districts

Attachment

RESOLUTION No.

Adopted by The Sacramento City Council on date of

**RESOLUTION CONCERNING THE LAND USE PLANNING
POLICY IN THE 100 YEAR FLOOD PLAIN**

BE IT RESOLVED BY THE COUNCIL OF THE CITY OF SACRAMENTO:

That the Land Use Planning Policy for the 100 year flood plain is hereby received and the Acting Environmental Coordinator is hereby instructed to report back within two weeks on the timetable, cost, funding and method of completing the environmental review.

MAYOR

ATTEST:

CITY CLERK

DRAFT-5/31/89

PROPOSED POLICY FOR DEVELOPMENT
IN THE AREAS AFFECTED BY THE SACRAMENTO RIVER LEVEE SYSTEM
IN THE CITY AND COUNTY OF SACRAMENTO FOR AN INTERIM PERIOD

BACKGROUND:

The flood provisions in the McKinney Homeless Assistance Act, signed by the President in November, 1988, provides the City and County with certain authority to regulate new construction which may be located in an area soon to be reclassified within the 100-year flood plain. In a January 3, 1989 letter to this community's local Congressional members, FEMA stated it expects this community "to live up to their representations to Congress as listed in the statute." Accordingly, the policies presently under consideration are intended to satisfy FEMA's expectation.

When discussing the status of development projects in the City and County vis-a-vis potential flood hazards it had been anticipated by staff, Board and Council members that individual decisions would have to be made on a project by project basis. This is still the case; however, in reviewing the January 1989 information provided by the U.S. Army Corps of Engineers, it is believed that some "general restrictions" on development should be imposed. These restrictions are being proposed in order to act reasonably and responsibly and in the interest of providing guidance to the development community. Additionally, it is felt that these restrictions are consistent with the City's and County's commitment to Congress during the period covered by the special legislation.

In making the policy recommendations outlined below, considerable thought has gone into review of the most significant flooding risks and problems faced by the City and County. To underscore the importance of levee stabilization, the Sacramento Metropolitan Flood Protection Task Force on February 9, 1989 officially adopted three major priorities for the Sacramento area.

PROPOSED POLICY

Page 2

1. Completion of stabilization work on the Sacramento River levee system.
2. Obtain 100 year flood protection.
3. Obtain 200 year flood protection.

From the perspective of risk, the City and County Public Works Departments have determined that the risk to inhabitants posed by a levee break in the Sacramento levee system is a concern the City and County should address before it considers other risks identified in the Corps information. This is a greater concern than the overtopping of the East Main Drain or Natomas Cross Canal levees because the build-up of water prior to overtopping would more than likely be gradual, and there should be time to evacuate potential flood victims. The possibility of levee failure or overtopping along the American River is dependent primarily upon flows in the Lower American River, which in turn are dependent upon releases from Folsom Dam. The increase in releases from Folsom Dam and consequent flows in the Lower American River will also be a gradual process. Although severe flooding from overtopping of levees could occur due to extremely high flows, there should be sufficient time to evacuate potential flood victims and thereby reduce the risk to those living in the area. Based on this review, it is believed that it would be appropriate to restrict some residential development in the geographic area affected by the Sacramento River levee system. It is anticipated that the construction contract for the levee reconstruction project will be awarded by July 1, 1990 at which time the staff anticipates recommending that the City Council and Board of Supervisors rescind these policies. At that time, the City Council and Board of Supervisors will determine if the flood risk is acceptable for

their respective jurisdictions. The recommendations are not intended to negate or lessen any existing flood control mitigation requirements for the flood plain identified in the February 1988 Flood Insurance Rate Maps.

Notwithstanding the above, it should be understood that property owners will still be required to sign the appropriate notices and waivers acceptable to the City Attorney and County Counsel until FEMA has notified the City and County that the 100 year flood protection has been achieved. In addition, applications for zoning or pre-zoning changes within the flood plain and not consistent with existing City and County General Plan from agricultural to urban use will not be approved during the period covered by the special legislation approved by Congress in 1988.

RESIDENTIAL VERSUS NON-RESIDENTIAL DEVELOPMENT:

In making a policy recommendation restricting development for an interim period, it is recommended that a distinction be made between residential development and non-residential development. There is less risk to life inherent in non-residential/commercial development than in residential development with respect to health and public safety concerns. Specific recommendations are proposed for non-residential development. Therefore it is recommended that non-residential/commercial development be allowed to proceed during this period.

While the City and County have evacuation plans which reduce the threat to life and property, the major health and public safety concern has to do with the stability problems of the Sacramento River levee system and the problems related to evacuation of the residents. This would be particularly critical if such an event

were to occur at night with little or no warning. Non-residential development on the other hand can be built with certain requirements which can mitigate a substantial amount of concern for health and public safety.

POINTS OF CONSIDERATION:

1. Health and Safety Issues/Economic Impact

The major concern in developing the policy recommendations has been for health and public safety. Also taken into account are the potential economic impacts of a complete halt to development in the area protected by the Sacramento River levee system. This area includes the Natomas area as well as other areas of the City and County shown on the attached map. Development in this area is critical to the economic viability of the Sacramento community. The policy recommendations outlining certain building restrictions separates residential from non-residential development. It is believed that the policy recommendations will have a limiting effect on residential development and that they are fair and supportive of health and public safety issues.

2. Insurance Requirements

Under the special legislation approved November 1988, FEMA has stated that flood insurance will be mandated for all new construction in the 100 year flood plain which is being federally financed, and such insurance can be obtained at the lower, subsidized rates. The proposed policy will strongly recommend obtaining such insurance whether it is mandated or not.

3. Notice and Waiver Requirements

These requirements are addressed in a separate report prepared by the City Attorney.

4. Substantive Expenditure on Existing Residential Projects

In developing a policy recommendation related to existing residential projects for which tentative maps or special permits, have been submitted, consideration has been given to the financial commitment and expenditure already made by property owners/developers in paying for streets, drainage and other necessary infrastructure. From the standpoint of sustaining the necessary relationships required for Sacramento to mount an effective flood control effort, it is recommended that these types of projects be allowed to proceed subject to the owner's signing all legal conditions and waivers as developed by the City Attorney's or County Counsel's office.

PROPOSED POLICY RECOMMENDATIONS

It is anticipated that the construction contract for the levee reconstruction project will be awarded by July 1, 1990 at which time the staff anticipates recommending that the City Council and Board of Supervisors rescind these policies. At that time, the City Council and Board of Supervisors will determine if the flood risk is acceptable for their respective jurisdictions. Except as noted, all proposed policies pertain to the geographic area as shown on the attached map. The recommendations are not intended to negate or lessen any flood control mitigation requirements for the flood plain identified in the February, 1988 Flood Insurance

Rate Maps. Notwithstanding the above, it should be understood that property owners will still be required to sign the appropriate notices and waivers acceptable to the City Attorney and County Counsel until FEMA has notified the City and County that the 100 year flood protection has been achieved. In addition, applications for zoning or pre-zoning changes within the flood plain and not consistent with existing City and County General Plan from agricultural to urban use will not be approved during the period covered by the special legislation approved by Congress in 1988.

POLICY RECOMMENDATION - CHANGE OF LAND USE

The City and County reaffirm their commitment to Congress not to designate any increases in urbanization beyond lands already so designated in the City's General Plan or in the County's pending General Plan update during the period covered by the special legislation. It is, however, understood that annexations where no increases in urbanization are contemplated will be processed. The County's General Plan is being prepared with the full knowledge of the flooding issues identified by the Corps of Engineers and the strategies and programs being developed by the City/County Office of Flood Control Planning. Policies will be developed for inclusion in the General Plan which support these strategies and which will prohibit construction in any flood hazard area until flood solutions are in place. Approval of General Plan designations will not automatically result in the ability to secure building permits consistent with those designations. Property owners must file and secure approval of zoning classifications which are consistent with General Plan designations. In addition to this commitment, applications for zoning or pre-zoning changes within the flood plain and not consistent with existing City and County General Plans from agricultural to urban use will not be

PROPOSED POLICY
Page 7

approved during the period covered by the special legislation approval by Congress in 1988.

POLICY RECOMMENDATION - DISCRETIONARY ENTITLEMENTS FOR RESIDENTIAL PROJECTS THAT HAVE BEEN FILED AFTER APRIL 1, 1989.

Tentative and final maps and other discretionary entitlements will continue to be processed. However, no building permit shall be approved by the City or County unless it can be shown that the project can be built in accordance with the Corps of Engineers' January, 1989 working maps, and any other applicable City and County regulations. A note to this effect shall be placed on the final map. The City and County shall take the necessary steps to remove this note when appropriate.

POLICY RECOMMENDATION - DISCRETIONARY ENTITLEMENTS FOR RESIDENTIAL PROJECTS THAT HAVE BEEN FILED BY APRIL 1, 1989

Existing residential projects which have tentative maps, final maps, special permits or plan reviews which have been filed prior to April 1, 1989 will be allowed to proceed subject to the owners' signing all legal conditions and waivers as developed by the City Attorney's or County Counsel's Office prior to recordation of final map or issuance of building permit whichever occurs first.

POLICY RECOMMENDATION - DEVELOPMENT AGREEMENTS

Property owners of properties under development agreements ("developers") have suggested that the agreements prohibit the City from delaying development of those properties until flood control measures are in place or contracted for. The City believes that the development agreement and federal authority may authorize the

PROPOSED POLICY
Page 8

City to delay development until flood protection measures are in place or contracted for. Both the City and these developers agree that the flooding risk pertains to the construction of buildings, not the approval of development entitlements such as tentative subdivision maps, final maps or special permits. Hence, the City will review on a case by case basis requests for entitlements for property under development agreements. The City may require that the property be built in accordance with the Corps of Engineers' January 1988 working maps, and other applicable City regulations.

POLICY RECOMMENDATION - NON-RESIDENTIAL BUILDINGS

Non-residential buildings shall be designed by an architect or civil engineer so as to minimize the extent of structural damage sustained in the event of a 100-year flood. Design standards to be used for the City will be prepared by the City Building Inspections Division. Design standards for the County will be prepared by the County Public Works Department. Projects accepted for plan check prior to April 1, 1989 will be exempt from these requirements.

The proposed City design standards are attached.

POLICY RECOMMENDATION - CITY/COUNTY WIDE

For the areas not affected by the Sacramento River levee system, no building permits for private projects (residential or non-residential) will be issued within the 100-year flood plain (as described in the January 1989 Corps information), unless all legal conditions and waivers as required by the City Attorney or County Counsel are executed by the property owner; or, it can be shown that the project can be built in accordance with the Corps of

PROPOSED POLICY
Page 9

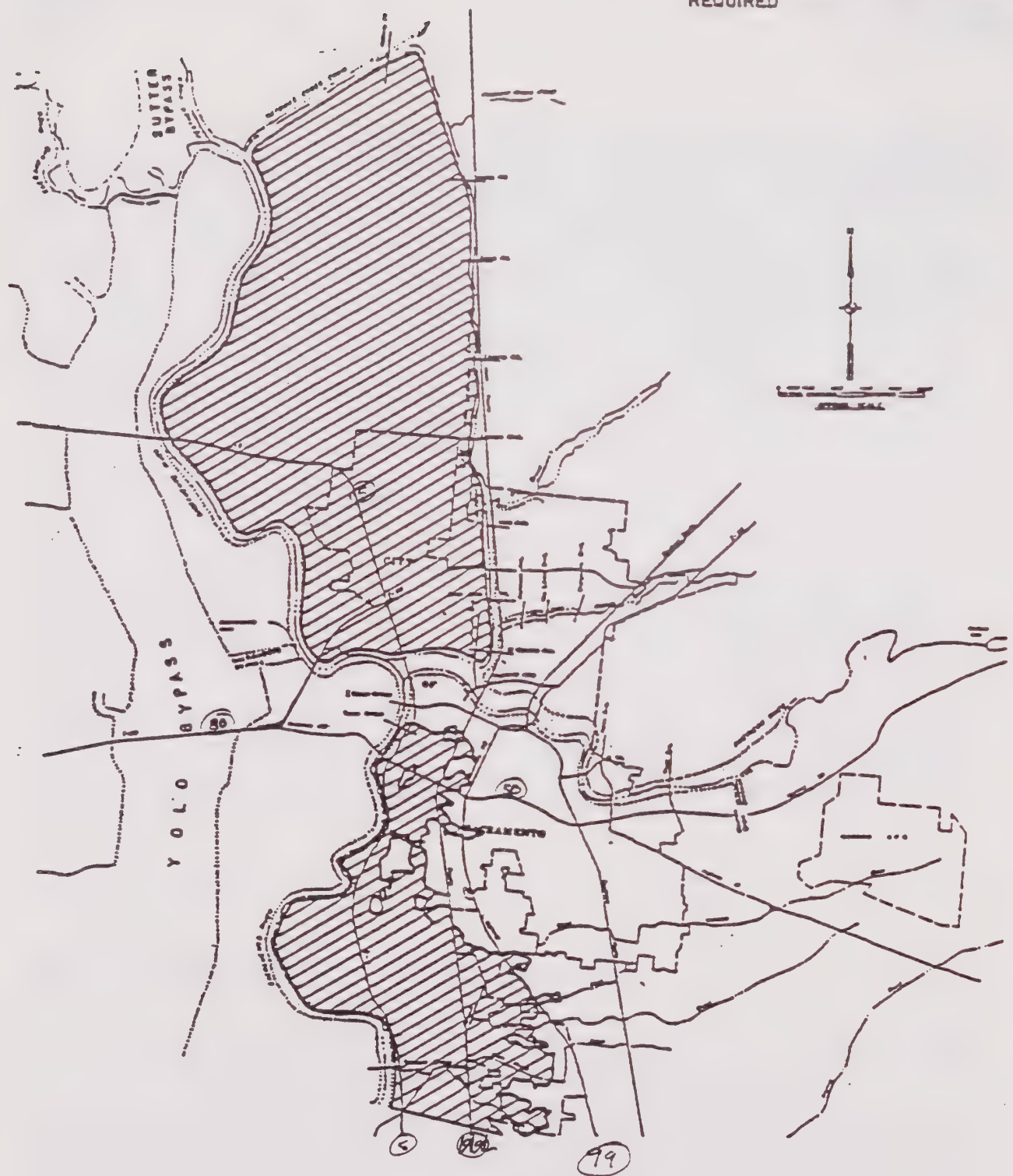
Engineers' 1989 working maps, and other applicable City and County regulations.

c:\wp50\packt\landuse.sr2

LEGEND:



SACRAMENTO RIVER FLOOD DAMAGE
WHERE REMEDIAL LEVEE REPAIRS
REQUIRED



PUBLIC WORKS DEPARTMENT
FEBRUARY 1969

SACRAMENTO RIVER
LEVEE FAILURE
FLOOD POTENTIAL
CITY OF SACRAMENTO

STRUCTURAL DESIGN STANDARDS
FOR NON-RESIDENTIAL BUILDINGS SUBJECT
TO FLOOD DAMAGE FROM THE SACRAMENTO RIVER

Purpose:

The intent of this standard is to minimize the extent of structural damage sustained in the event of a hundred-year flood. It is recognized that buildings constructed in conformance with its provisions may sustain some degree of damage as the result of flooding.

Scope:

This standard applies to new non-residential construction located within the geographic area subject to flood damage from the Sacramento River. Nothing in this standard is intended to restrict the applicant from complying with the flood-proofing standards for non-residential construction (See Section 9.1005 A.3.C of the Flood Plain Management Regulations). The provisions of this standard are not intended to prevent the use of any material or method not specifically prescribed, provided any alternate has been approved and its use is authorized by the Building Official.

Standard:

Fully enclosed non-residential buildings that are subject to flooding shall be designed to equalize hydrostatic flood forces on the exterior walls by allowing for the entry and exit of flood water as follows:

Openings covered by glazing or overhead doors may be assumed to allow entry and exit of flood water. These openings shall

Standards (Continued):

be provided at the rate of 3 square inches for each square foot of floor area. The location of the required openings shall be reasonably distributed along the perimeter of the building, and shall be located within 2' of the ground surface or lowest floor level.

Alternate means for entry and exit of flood water may be designed. Systems shall be sized to allow flood water to enter or exit at a sufficient rate to keep up with an external rise or drop in static head equal to one-foot per hour (1 ft./hour). A static head differential of 2 ft. may be assumed between interior and exterior water surfaces for design purposes.

APPENDIX B

NOTICE OF PREPARATION



DEPARTMENT OF
PLANNING AND DEVELOPMENT

CITY OF SACRAMENTO
CALIFORNIA

1231 I STREET
ROOM 200
SACRAMENTO, CA
95814-2998

BUILDING INSPECTIONS
916-449-5716

PLANNING
916-449-5604

July 18, 1989

MEMORANDUM

TO: Interested Persons

FROM: Jim Harnish, Acting Environmental Coordinator for the City of
Sacramento *BW for*

SUBJECT: NOTICE OF PREPARATION OF A DRAFT
ENVIRONMENTAL IMPACT REPORT ON THE
LAND USE PLANNING POLICY WITHIN THE
100-YEAR FLOOD PLAIN IN THE CITY OF SACRAMENTO

The City of Sacramento is the lead agency for the preparation of an Environmental Impact Report (EIR) on the land use planning policy within the 100-year flood plain in the City of Sacramento.

The Land Use Planning Policy for the 100-year flood plain has been developed in response to new information from the U.S. Army Corps of Engineers and the Federal Emergency Management Agency that indicate a need for increased flood control measures in order to provide 100-year flood protection for all areas within the City of Sacramento.

The attached initial study defines the proposed "project" and outlines the scope and content of the EIR. Comments on the scope and content should be addressed to:

Barbara L. Wendt
Sacramento City Environmental Division
1231 "I" Street, Room 300
Sacramento, CA 95814

All comments must be received by 5:00 PM, August 17, 1989. Thank you for your participation in this important City project.

JH:BW:rt



CITY OF SACRAMENTO

INITIAL STUDY

This Initial Study has been required and prepared by the Department of Planning and Development, Planning Division, Environmental Section, 1231 I Street, Suite 300, Sacramento, CA 95814, (916)449-2037, pursuant to CEQA Guidelines Section 15063 (August 1, 1983).

File No. and/or Project Name: LAND USE POLICY WITHIN THE 100-YEAR FLOOD PLAIN

Applicant - Name: CITY OF SACRAMENTO

Address: 1231 "I" STREET, ROOM 301

SACRAMENTO, CA 95814

Answer the following questions to determine if the proposed project may have potentially adverse significant impacts on the environment.

- | | <u>Yes or No</u> |
|---|------------------|
| 1. <u>Earth</u> . Will the proposal result in: | |
| a. Unstable earth conditions or in changes in geologic substructures? | <u>NO</u> |
| b. Disruptions, displacements, compaction or overcovering of the soil? | <u>NO</u> |
| c. Change in topography or ground surface relief features? | <u>NO</u> |
| d. The destruction, covering or modification of any unique geologic or physical features? | <u>NO</u> |
| e. Any increase in wind or water erosion of soils, either on or off the site? | <u>NO</u> |
| f. Changes in deposition or erosion of beach sands, or changes in siltation, deposition or erosion which may modify the channel of a river, stream, bay, inlet or lake? | <u>NO</u> |
| g. Exposure of people or property to geologic hazards such as earthquakes, ground failure, or similar hazards? | <u>NO</u> |
| 2. <u>Air</u> . Will the proposal result in: | |
| a. Substantial air emissions or deterioration of ambient air quality? | <u>NO</u> |
| b. The creation of objectionable odors? | <u>NO</u> |
| c. Alteration of air movement, moisture or temperature, or any change in climate, either locally or regionally? | <u>NO</u> |
| 3. <u>Water</u> . Will the proposal result in: | |
| a. Changes in currents, or the course of direction movements, in either marine or fresh waters? | <u>NO</u> |
| b. Changes in absorption rates, drainage patterns, or the rate and amount of surface runoff? | <u>NO</u> |
| c. Alterations to the course of flow of flood waters? | <u>NO</u> |
| d. Change in the amount of surface water in any water body? | <u>NO</u> |
| e. Discharge into surface waters, or in any alteration of surface water quality, including but not limited to temperature, dissolved oxygen or turbidity? | <u>NO</u> |
| f. Alteration of the direction or rate of flow of ground waters? | <u>NO</u> |
| g. Change in the quantity of ground waters, either through direct additions or withdrawals, or through interception of an aquifer by cuts or excavations? | <u>NO</u> |
| h. Substantial reduction in the amount of water otherwise available for public water supplies? | <u>NO</u> |
| i. Exposure of people or property to water related hazards such as flooding? | <u>YES</u> |
| 4. <u>Plant Life</u> . Will the proposal result in: | |
| a. Change in the diversity of species, or number of any species of plants? | <u>NO</u> |
| b. Reduction of the numbers of any unique, rare or endangered species of plants? | <u>NO</u> |
| c. Introduction of new species of plants into an area, or in a barrier to the normal replenishment of existing species? | <u>NO</u> |
| d. Reduction in acreage of any agricultural crop? | <u>NO</u> |
| 5. <u>Animal Life</u> . Will the proposal result in: | |
| a. Change in the diversity of species, or number of any species of animals? | <u>NO</u> |
| b. Reduction of the numbers of any unique, rare or endangered species of animals? | <u>NO</u> |
| c. Introduction of new species of animals into an area, or result in a barrier to the migration or movement of animals? | <u>NO</u> |
| d. Deterioration of existing fish or wildlife habitat? | <u>NO</u> |

| | Yes or No |
|--|------------|
| 6. <u>Noise</u> . Will the proposal result in: | |
| a. Increases in existing noise levels? | <u>NO</u> |
| b. Exposure of people to severe noise levels? | <u>NO</u> |
| 7. <u>Light and Glare</u> . Will the proposal produce new light or glare? | <u>NO</u> |
| 8. <u>Land Use</u> . Will the proposal result in a substantial alteration of the present or planned land use of an area? | <u>NO</u> |
| 9. <u>Natural Resources</u> . Will the proposal result in: | |
| a. Increase in the rate of use of any natural resources? | <u>NO</u> |
| b. Substantial depletion of any nonrenewable natural resource? | <u>NO</u> |
| 10. <u>Risk of Upset</u> . Does the proposal involve: | |
| a. A risk of an explosion or the release of hazardous substances (including, but not limited to, oil, pesticides, chemicals or radiation) in the event of an accident or upset conditions? | <u>NO</u> |
| b. Possible interference with an emergency response plan or an emergency evacuation plan? | <u>YES</u> |
| 11. <u>Population</u> . Will the proposal alter the location, distribution, density, or growth rate of the human population of an area? | <u>NO</u> |
| 12. <u>Housing</u> . Will the proposal affect existing housing, or create a demand for additional housing? | <u>NO</u> |
| 13. <u>Transportation/Circulation</u> . Will the proposal result in: | |
| a. Generation of substantial additional vehicular movement? | <u>NO</u> |
| b. Effects on existing parking facilities, or demand for new parking? | <u>NO</u> |
| c. Substantial impact upon existing transportation systems? | <u>NO</u> |
| d. Alterations to present patterns of circulation or movement of people and/or goods? | <u>NO</u> |
| e. Alterations to waterborne, rail or air traffic? | <u>NO</u> |
| f. Increase in traffic hazards to motor vehicles, bicyclists or pedestrians? | <u>NO</u> |
| 14. <u>Public Services</u> . Will the proposal have an effect upon, or result in need for new or altered governmental services in any of the following areas: | |
| a. Fire protection? | <u>NO</u> |
| b. Police protection? | <u>NO</u> |
| c. Schools? | <u>NO</u> |
| d. Parks or other recreational facilities? | <u>NO</u> |
| e. Maintenance of public facilities, including roads? | <u>NO</u> |
| f. Other governmental services? | <u>NO</u> |
| 15. <u>Energy</u> . Will the proposal result in: | |
| a. Use of substantial amounts of fuel or energy? | <u>NO</u> |
| b. Substantial increase in demand upon existing sources of energy or require the development of new sources of energy? | <u>NO</u> |
| 16. <u>Utilities</u> . Will the proposal result in a need for new system, or substantial alterations to the following utilities: | <u>NO</u> |
| a. Power or natural gas? | <u>NO</u> |
| b. Communications systems? | <u>NO</u> |
| c. Water? | <u>NO</u> |
| d. Sewer or septic tanks? | <u>NO</u> |
| e. Storm water drainage? | <u>NO</u> |
| f. Solid waste and disposal? | <u>NO</u> |

Yes or No

17. Human Health. Will the proposal result in:
- a. Creation of any health hazard or potential health hazard (excluding mental health)? NO
 - b. Exposure of people to potential health hazards? YES
18. Aesthetics. Will the proposal result in the obstruction of any scenic or view open to the public, or will the proposal result in the creation of an aesthetically offensive site open to public view? NO
19. Recreation. Will the proposal result in an impact upon the quality or quantity of existing recreational opportunities? NO
20. Cultural Resources.
- a. Will the proposal result in the alteration or destruction of a prehistoric or historic archaeological site? NO
 - b. Will the proposal result in adverse physical or aesthetic effects to a prehistoric or historic building, structure or object? NO
 - c. Does the proposal have the potential to cause a physical change which would affect unique ethnic cultural values? NO
 - d. Will the proposal restrict existing religious or sacred uses within the potential impact area? NO
21. Mandatory Findings of Significance.
- a. Does the project have the potential to degrade the quality to the environment, substantially reduce the habitat of a fish or wildlife population to drop below self-sustaining levels, threaten to eliminate a plant or animal community, reduce the number or restrict the range of a rare or endangered plant or animal or eliminate important examples of the major periods of California history or prehistory? NO
 - b. Does the project have the potential to achieve short-term, to the disadvantage of long-term, environmental goals? (A short-term impact on the environment is one which occurs in a relatively brief, definitive period of time while long-term impacts will endure well into the future.) NO
 - c. Does the project have impacts which are individually limited, but cumulatively considerable? (A project may impact on two or more separate resources where the impact on each resource is relatively small, but where the effect of the total of those impacts on the environment is significant.) NO
 - d. Does the project have environment effects which will cause substantial adverse effects on human beings, either directly or indirectly? MAYBE

DETERMINATION

On the basis of this initial evaluation:

- ____ I find the proposed project COULD NOT have a significant effect on the environment, and a NEGATIVE DECLARATION will be prepared.
- ____ I find that although the proposed project could have a significant effect on the environment, there will not be a significant effect on this case because the mitigation measures described in this Initial Study has been added to the project. A NEGATIVE DECLARATION WILL BE PREPARED.
- X I find the proposed project MAY have a significant effect on the environment, and an ENVIRONMENTAL IMPACT REPORT is required.

DATE: July 17, 1989

SIGNATURE: 

PREPARED BY: Jim Harnish

PHONE: 449-2037

LAND USE POLICY WITHIN THE 100-YEAR FLOOD PLAIN

III. PROJECT DESCRIPTION

A. Introduction to the Project Description

The "project" under evaluation in this Environmental Impact Report (EIR) is a proposed land use planning policy for the 100-year flood plain. As described below, the project location refers to the areas which would be affected by the policy; the project objectives refer to the objectives of the City and County in implementing the policy; the project characteristics are the specific elements of the proposed land use policy; and project approvals refer to actions which must be taken by the City or the County in order to fully implement the policy.

Additional information is provided regarding the historical background which has lead to the proposed policy and the various assumptions which have been made regarding the level of flood protection which will be provided to a particular area as a result of the ongoing phased flood protection efforts. These efforts substantially affect the ultimate implications of the proposed policy in that they affect the time period and ultimate levels of flood protection which will be offered in the existing flood plain areas.

B. Project Location

The proposed policy would apply to all development in areas of the City of Sacramento and Sacramento County located in the flood plain identified on the preliminary Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) and the Special Map (Sacramento River Levee Failure Flood Potential Map) attached to the policy.

C. Project Characteristics

The Task Force has presented the City and County with a set of proposed policies related to land use and notification which, it believes, responds to the requirements of the special legislation. The proposed Land Use Planning Policy Within the 100-Year Flood Plain contains several specific elements which identify the type and timing of development within the flood plain. The Task Force has recommended that the policies be in place "until approximately July 1, 1990 and until the City Council and Board of Supervisors determine that the nature of the flood risk is acceptable for their respective jurisdictions." The Task Force staff anticipates recommending that the City Council and the Board of Supervisors rescind these policies, with the exception of the Change of Land Use policy, once contracts for levee stabilization have been awarded and the decision makers determine that the flood risk is acceptable. There is, however, no requirement that they do so.

The proposed Land Use Planning Policy Within The 100-Year Flood Plain and the Special Map contains the following five elements:

■ Change of Land Use

"The City and County reaffirm their commitment to Congress not to designate any increases in urbanization beyond lands already so designated in the City's General Plan or in the County's pending General Plan update during the period covered by the special legislation. It is, however, understood that annexations where no increases in urbanization are contemplated will be processed. The County's General Plan is being prepared with the full knowledge of the flooding issues identified by the COE and the strategies and programs being developed by the City/County Office of Flood Control Planning. Policies will be developed for inclusion in the General Plan which support these strategies and which will prohibit construction in any flood hazard area until flood solutions are in place. Approval of General Plan designations will not automatically result in the ability to secure building permits consistent with those designations. Property owners must file and secure approval of zoning classifications which are consistent with General Plan designations. In addition to this commitment, applications for zoning or pre-zoning changes within the flood plain and not consistent with existing City and County General Plans from agricultural to urban use will not be approved during the period covered by the special legislation approval by Congress in 1988."

The following four policy elements apply only to that portion of the 100-year flood plain designated as the Sacramento River Levee Failure Flood Potential Map, shown in Figure 1. These elements will stay in effect until construction contracts for levee stabilization are awarded and the City Council and Board of Supervisors determine that the flood risk is acceptable.

■ Discretionary Entitlements For Residential Projects That Have Been Filed After April 1, 1989

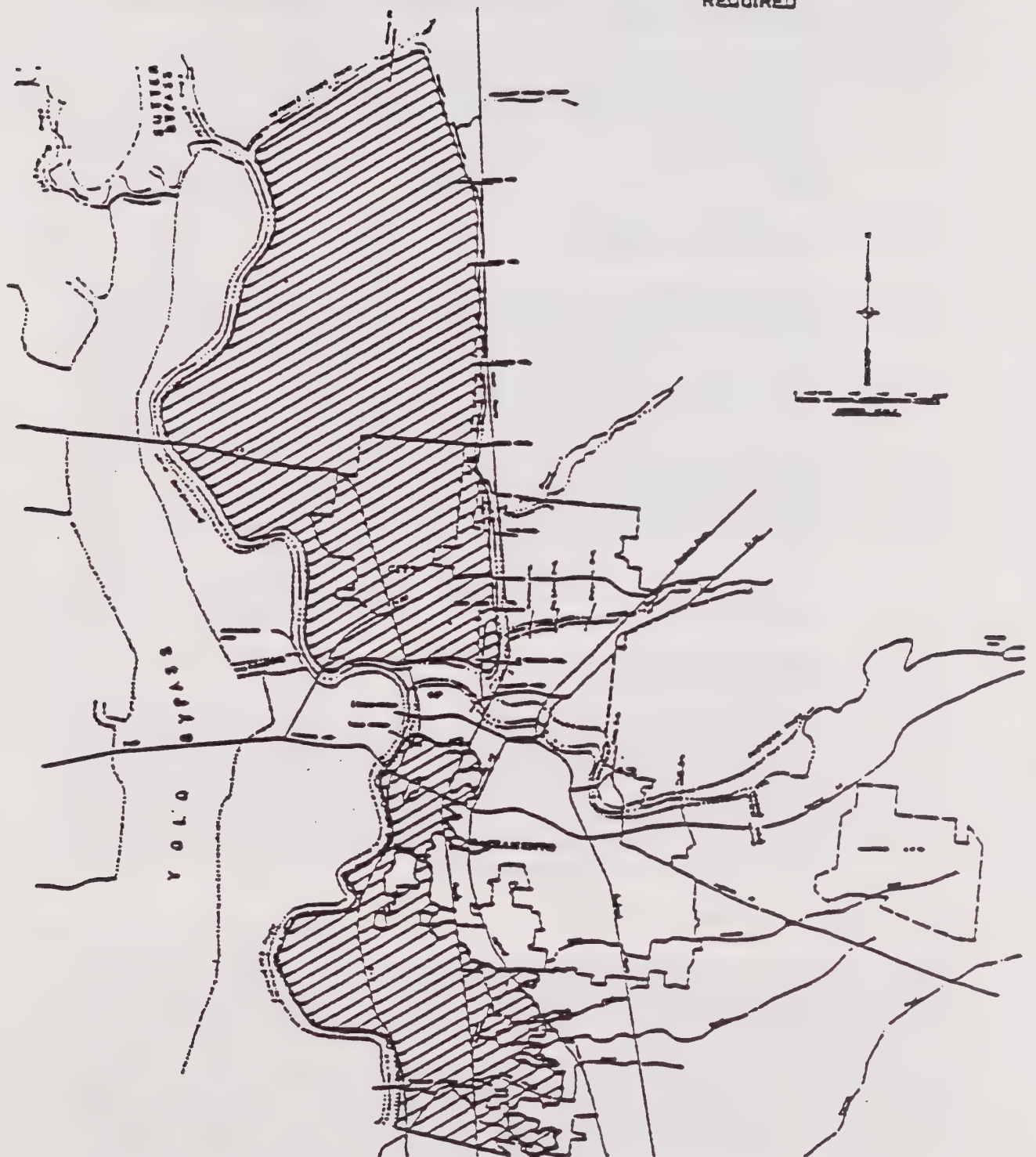
"Tentative and final maps and other discretionary entitlements will continue to be processed. However, no building permits shall be approved by the City or County unless it can be shown that the project can be built in accordance with the COE January, 1989 working maps, and any other applicable City and County regulations. A note to this effect shall be placed on the final map. The City and County shall take the necessary steps to remove this note when appropriate."

FIGURE 1

LEGEND:



SACRAMENTO RIVER FLOOD DAMAGE
WHERE REMEDIAL LEVEE REPAIRS
REQUIRED



■ Discretionary Entitlements For Residential Projects That Have Been Filed By April 1, 1989

"Existing residential projects which have tentative maps, final maps, special permits or plan reviews which have been filed prior to April 1, 1989 will be allowed to proceed subject to the owners' signing all legal conditions and waivers as developed by the City Attorney's or County Counsel's Office prior to recordation of final map or issuance of building permit whichever occurs first."

■ Development Agreements

"Property owners of properties under development agreements ('developers') have suggested that the agreements prohibit the City from delaying development of those properties until flood control measures are in place or contracted for. The City believes that the development agreement and federal authority may authorize the City to delay development until flood protection measures are in place or contracted for. Both the City and these developers agree that the flooding risk pertains to the construction of buildings, not the approval of development entitlements such as tentative subdivision maps, final maps or special permits. Hence, the City will review on a case-by-case basis requests for entitlements for property under development agreements. The City may require that the property be built in accordance with the COE January 1988 working maps, and other applicable City regulations."

■ Non-Residential Buildings

"Non-residential buildings shall be designed by an architect or civil engineer so as to minimize the extent of structural damage sustained in the event of a 100-year flood. Design standards to be used for the City will be prepared by the City Building Inspections Division. Design standards for the County will be prepared by the County Public Works Department. Projects accepted for plan check prior to April 1, 1989 will be exempt from these requirements."

The City design standards are as follows:

- "Fully enclosed non-residential buildings that are subject to flooding shall be designed to equalize hydrostatic flood forces on the exterior walls by allowing for the entry and exit of flood water as follows:

"Openings covered by glazing or overhead doors may be assumed to allow entry and exit of flood water. These openings shall be provided at the rate of three square inches for each square foot of floor area. The location of the required openings shall be reasonably distributed along the perimeter of the building, and shall be located within two feet of the ground surface or west floor level.

"Alternate means for entry and exit of flood water may be designed. Systems shall be sized to allow flood water to enter or exit at a sufficient rate to keep up with an external rise or drop in static head equal to one foot per hour. A static head differential of two feet may be assumed between interior and exterior water surfaces for design purposes."

D. Project Objectives

The City and County of Sacramento have several objectives in proposing this policy. These objectives include the following:

- ✱ To comply with the intent and spirit of the flood protection provisions of the McKinney Homeless Assistance Act of 1988 (H.R. 5247) ("Special Legislation");
- ✱ To avoid undue exposure to the risks of floods; and
- ✱ To minimize potential disruption in the Sacramento region and to avoid the precipitous break-up of the political, institutional, and economic relationships sustaining the high level, comprehensive, flood protection effort.

E. Historical Background

Prior to 1986, it was believed that urban Sacramento's 110-mile levee system was sufficient to withstand at least a 100-year flood. A 100-year flood is a flood of such magnitude that it has a likelihood of occurring once every 100 years; in other words, there is a one percent chance of a 100-year flood occurring in any given year. In order to withstand a 100-year flood, the rivers and levee systems would have to be stable and able to contain a 100-year flood flows while maintaining a minimum level of 8 feet of "freeboard," the distance between the water level the levee was designed for and the top of the levee. Federal regulations require a minimum of 3 feet of freeboard.

Existing Flood Control System

Flood control facilities along the Sacramento and American River drainages consist of a comprehensive system of dams, levees, overflow weirs (diversion structures in the river intended to ensure a maximum flow in the river), drainage pumping plants, and flood control by-pass channels. Such facilities harness the flood flows by regulating the amount of water passing through a particular reach of the river. The American River flood control system was planned with a design flow at Folsom Dam of 115,000 cubic feet per second (cfs), while the Sacramento River flood control system was designed to hold the maximum flow of about 110,000 cfs.

Sacramento River Flood Control System

Primary elements of the Sacramento River Flood Control System include the following:

- Fremont Weir;
- Sacramento Weir;
- Yolo By-Pass Channel;
- Sacramento By-Pass Channel; and
- Levees along the Sacramento River, Lower American River, Natomas East Main Drainage Channel (NEMDC), Arcade Creek, Natomas Cross Channel and the Yolo By-Pass Channels.

The design flow of the Sacramento River System from Fremont Wier to the Sacramento Weir is 107,000 cfs and downstream of the American River is 110,000 cfs. The levees along both sides of the Sacramento River were designed to carry these flows with at least three feet of freeboard. Excess flood waters are discharged through the Fremont and Sacramento Weirs and into the Sacramento and/or Yolo By-Pass Channels.

American River Flood Control System

The American River Flood Control System includes the following primary elements:

- Folsom Dam (a 340 foot high concrete-earthfill dam on the main stem of the American River);
- Nimbus Dam, a Folsom afterbay;
- One auxiliary dam at Mormon Island;
- Eight earthfill dikes; and
- About four miles of levees on the north bank of the American River (from Howe Avenue to Arden Way).

The American River System was designed with a design flow from Folsom Dam of 115,000 cfs. The levee system downstream of Folsom was designated to accommodate 115,000 cfs with five feet of freeboard.

The Flood of 1986

The February 1986 storm produced record flows in both the Sacramento and American River drainages. The American River's levees were designed to have five feet of freeboard and handle a flow of 115,000 cfs with 5 feet of freeboard. At one point in the storm, the river above the Natomas area carried about 134,000 cfs, 19,000 cfs (or 16.5 percent) higher than its design capacity. The levees contained the flow from the storm but, in many cases, there was encroachment into the design freeboard and erosion of the levee embankment.

During the same storm, the Sacramento River also experienced the highest stage ever recorded. At the "I" Street Bridge in downtown Sacramento, the system had been designed to have a minimum of three feet of freeboard and handle 110,000 cfs.

The flow peaked at 117,000 cfs. At some locations along the river, the peak left between one to two feet of freeboard remaining. The Sacramento River levee along the Garden Highway, north of Metro Airport, began to slip. During the storm, ten separate slips occurred and were repaired on the land side of the levee.

An outgrowth of the 1986 floods was a reevaluation of the size of the 100-year flood event, the condition of existing levees and the level of protection of the existing flood control system. Subsequent studies by the U.S. Army Corps of Engineers (COE) have found that the 100-year flood event was much larger than previously thought and that the existing American River flood control system only provides an average flood protection of only 63 years, with as little as 40 years in some parts of Natomas.

Regulatory Response

In response to the increased concern about flood protection in the Sacramento area, six separate studies were initiated, each evaluating three levels of protection: current, 100-year, and 200-year. Briefly described, the six studies are:

■ Sacramento River Flood Control System Evaluation

Assessment of specified sections of the Sacramento River Flood Control Project to determine if they can perform as originally designed. The first phase of this study determined that 32 miles of levees protecting urban Sacramento were unstable and needed remedial work if they were to perform as originally designed. Additional phases of this study will evaluate other portions of the Sacramento River system from Chico Landing in the north to Collinsville in the south.

■ FEMA Flood Plain Mapping

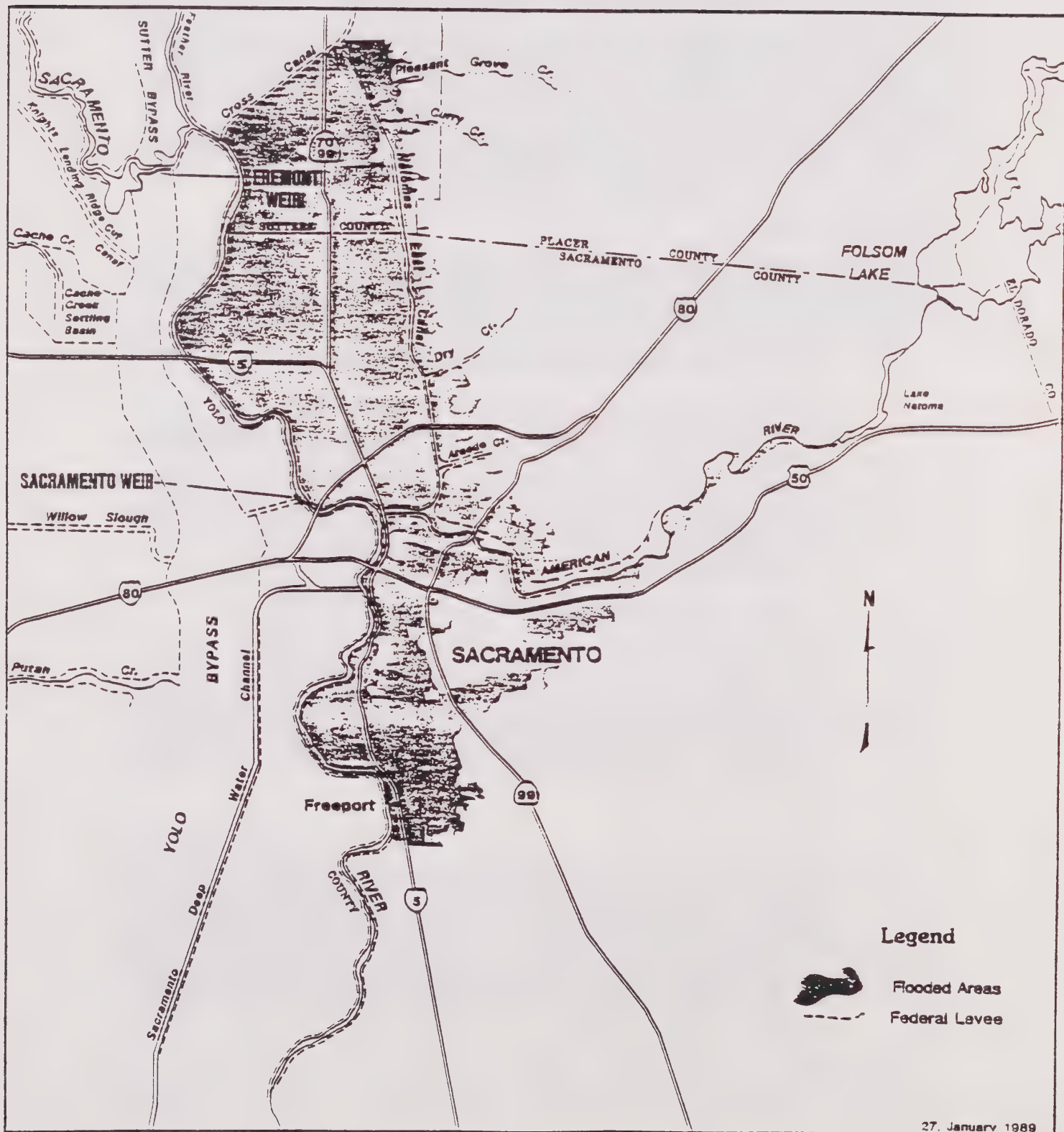
The COE mapped the 100-year flood plain for Sacramento, based on new rainfall runoff their most recent evaluation of the levee system, and turned the maps over to the City and County in November 1988. In January 1989, the maps were given to FEMA. That agency issued preliminary maps in May 1989 and anticipating issuing final maps before the end of 1989 (see Figure 2).

■ Folsom Reoperation

The COE is evaluating the potential for acquisition of additional upstream storage on the American River through the reoperation of Folsom Dam. Reoperation involves the allocation of greater storage capacity in Folsom Lake for storm flows. The COE is looking at alternatives to increase the flood storage and evaluating the related effects on flood control, supply and use of water, and the environment. A draft report and Environmental Impact Statement (EIS) should be available in October 1989.

PROPOSED 100-YEAR FLOOD PLAIN FOR
THE SACRAMENTO AND AMERICAN RIVERS
(Based on the January 1989 FEMA Working Map)

FIGURE 2



■ Dry Creek (Roseville)

The COE is evaluating flooding along the Dry Creek drainage through the City of Roseville.

■ Sacramento Metropolitan Area

The study area reaches from Fremont Weir (near the confluence of the Sacramento and the Feather Rivers) to Freeport. This study for the State Reclamation Board will determine the extent of problems of the flood control system and will recommend feasible alternative solutions.

■ American River Watershed

The American River Watershed Feasibility Study began in July 1988, and is evaluating alternatives for providing higher levels of protection on the American river flood control system. The study, to date, has concluded the existing facilities only provide 63-year level of flood protection and is investigating alternatives to provide at least a 200-year level of protection.

Legislative Response

Special legislation contained in the McKinney Homeless Assistance Act of 1988, passed by Congress and signed by the President in November 1988, established the legal framework within which Sacramento's governmental authorities are authorized to respond to recently updated based flood elevations for the greater Sacramento area. These new flood elevations were determined by the COE for FEMA and indicate a large portion of the City and western County area lie within a flood plain. The special legislation prohibits FEMA from using these new flood water surface elevations to impose new flood insurance rates and design and use restrictions in Sacramento, and permits existing elevations and rates to be continued for up to four years as necessary in order to give Sacramento an opportunity to mount an effective flood control effort. Specifically, the special legislation does not prevent the City and County from permitting such new development at existing elevations and insurance rates as may be required to preserve the institutional and economic relationships necessary to sustain an effective flood control protection effort. In exercising this authority, the City and County are obligated to avoid undue exposure to the dangers of floods and to comply to the maximum extent practicable with FEMA's updated based flood elevations.

In order to participate in the National Flood Insurance Program (NFIP) and thereby mitigate potential losses due to flooding, the City and County must satisfy certain statutorily mandated flood plain management criteria. These criteria, along with the actuarial (risk-based) insurance rates applicable under the NFIP, are established on the basis of flood map elevation determinations made by the Director of FEMA pursuant to the provision of the National Flood Insurance Act of 1968. Based on studies by the COE, indicating increased vulnerability attributable to increased

estimates of the frequency of large storms in the region, FEMA has reanalyzed the flood risks in the Sacramento area and concluded that a larger portion of the City and County lie within the 100-year flood plain.

In adopting the 1988 special legislation, Congress has recognized that changed flood water surface elevation requirements attributable to a change in flood water surface elevation determinations by FEMA could cause severe disruption in the Sacramento region and could undermine the community's ability to carry out an effective flood protection effort. To avoid this consequence, the special legislation prohibits FEMA from imposing any new elevation requirements in the Sacramento area for up to four years. This prohibition effectively precludes FEMA from charging actuarial flood insurance rates within the Sacramento area. Accordingly, FEMA has agreed to continue to make flood insurance available at rates normally utilized outside areas of special flood hazard.

Sacramento Metropolitan Flood Protection Task Force

The Sacramento Metropolitan Flood Protection Task Force ("Task Force") was established with the task of overseeing Sacramento's local efforts to provide additional flood protection to the greater Sacramento area. After nearly two months of discussions with interested parties, the Task Force has recommended a set of policies to initiate Sacramento's flood planning effort. The Land Use Planning Policy Within 100 Year Flood Plain, presented to the Sacramento City Council on June 7, 1989, embodies the land use element of the City's initial effort to ensure that development which occurs within the 100-year flood plain is consistent with the intent of the special legislation.

F. Other Elements of the Flood Protection Effort

The proposed project (the land use policy) is only one part of a comprehensive effort to respond to existing flood protection conditions and to improve the overall level of flood protection. There are other elements of the overall flood protection effort which are not evaluated in this document as part of the project. These other elements are discussed below. Each of these other elements will be evaluated, if necessary, under the appropriate CEQA or NEPA processes.

Notification Requirements

The Task Force has recommended and the City has adopted an ordinance to establish procedures for notification of new home purchasers and others of the risk of flooding in areas of the City lying within the 100-year flood plain. The policy is also designed to provide the City with legal protection in the event it is determined that the City may be held liable for flood-related damages as a result of permitting new construction in the floodplain. The following summarizes the elements of the notification policy:

■ Notice

The City is required to work with local title insurance companies and real estate associations to develop a procedure for giving actual notice to buyers of new construction in the flood plain. Under this procedure, notice would be given before the close of escrow by the real estate agent and/or through the title company involved in the transaction. Notice would be given both to new home purchasers and to purchasers of these homes at resale.

■ Assumption of Risk

It is required that prior to issuance of a building permit for any new construction in the flood plain, the owners of the affected property sign an agreement with the City acknowledging and assuming the risk of flooding, waiving any flood-related claims against the City and indemnifying the City against any such claims. The agreement further requires that the owner give notice of the flood danger to any person who subsequently acquires an ownership, possessory or security interest in the property and obtain from any such person a waiver of the flood-related claims on behalf of the City. Compliance with this third-part notice and waiver provision entitles the owner to be released from any obligation to indemnify the City.

Commercial lessees who are installing substantial tenant improvements may also be required to sign the agreement. Persons engaged in residential remodelling would be required to sign a modified form of the agreement containing the assumption of risk and waiver provisions but eliminating the indemnification provision.

The City has determined that these notification policies do not constitute a project under CEQA and, therefore, no environmental review of these policies is required.

Physical Flood Protection Improvements

The policy level responses to the current flood protection situation are only one element of the comprehensive flood protection effort. Both of the policies (land use policy and notification policy) are reliant upon eventual physical improvements which will increase flood protection in all parts of Sacramento. There are three essential elements of the flood control effort: levee stabilization, reoperation of Folsom Dam, and levee improvement.

Levee Stabilization

The first phase of the Sacramento River Flood Control System Evaluation determined that a total of 32 miles of levees along the Sacramento River were in need of remedial work to correct latent construction defects and to bring the levees up to existing standards. The estimated cost of repairing these levees is \$38 million. The primary effect of this stabilization project will be to increase flood protection in

the Natomas area from the existing 40-year to about 50-year flood. Flood protection in other areas will remain at about 63 years. The COE is currently awaiting approval to begin engineering and design work to correct the levee deficiencies. Prior to start of this project, environmental evaluation under the provisions of the National Environmental Protection Act (NEPA) will be undertaken. It is anticipated that this project will be completed by 1993.

Reoperation of Folsom Dam

Reoperation of Folsom Dam would involve the reservation of greater storage capacity in Folsom Lake during the November to April flood season. Provision of an additional 100,000 acre feet of storage (over existing storage levels) in Folsom Lake would provide an unknown degree of flood protection for Natomas and 75-year flood protection for the remainder of Sacramento. This study assumes that reoperation to accommodate this amount will be accomplished by 1992.

Provision of an additional 190,000 acre feet of storage (over existing storage levels) in Folsom Lake would provide an unknown degree of flood protection for Natomas and 100-year flood protection for the remainder of Sacramento.

Levee Improvement

Beyond levee stabilization, improvement of area levees, including raising their height, can provide additional flood protection. It is anticipated that levee improvement along portions of Sacramento River, American River, Natomas East Main Drainage Channel, Dry Creek, Arcade Creek, and Morrison Creek, in combination with reoperation of Folsom Dam to provide a minimum of 100,000 acre feet of additional storage, could provide all of Sacramento with 100-year flood protection.

G. Project Approvals

It is expected that the City Council and the Board of Supervisors will adopt the Land Use Planning Policy Within the 100-Year Flood Plain as ordinances. It is further expected that those ordinances will be rescinded at some time in the future, at the discretion of each representative body.

This EIR will be published and circulated for public comment for a period of 45 days, from October 13 through November 27, 1989. Written comments from the public and other interested agencies may be submitted at any time during the comment period. There will be a public hearing on the Draft EIR before the City Council during the comment period. After the close of the comment period, the EIR authors will respond in writing to all comments submitted during the comment period and at the public hearing. The comments and responses will be published for review of the City Council prior to their action on certification of the EIR. The Draft EIR and the Comments and Responses, including any revisions of the Draft EIR contained therein, will constitute the Final EIR which the City Council will evaluate for certification as to its objectivity, accuracy, and completeness.

***LAND USE POLICY WITHIN THE
100-YEAR FLOOD PLAIN***

ALTERNATIVES

The following alternatives will be evaluated in the EIR:

- ✱ **Proposed Project:**

The project as described in the attached project description.
- ✱ **No Project:**

This alternative would assume no action on the part of the City or County to adopt the proposed land use policy. Development and planning processes would proceed as they are at the present time.
- ✱ **Application of the Existing Flood Plain Management Regulations based on new FIRM Maps:**

This alternative would evaluate the implications of a policy by the City and County to apply their existing flood plain management regulations to all new development in the 100-year flood plain.
- ✱ **Application of the Proposed Land Use Policy to Non-Residential Structures Only:**

This alternative would apply the proposed land use policy to non-residential structures; residential development occurring within the 100-year flood plain would be required to comply with existing flood plain management regulations of the City and County.

LAND USE POLICY WITHIN THE 100-YEAR FLOOD PLAIN

SCOPE OF THE EIR

Land Use

The land use analysis will present the following information:

- ✱ Existing and projected levels of growth (development and population) within pertinent subareas of the 100-year flood plain. Projections will be made for relevant time periods in relation to anticipated completion dates for elements of the flood protection effort.
- ✱ Evaluation of the implications of the proposed land use policy on projected growth levels. This will be compared to existing development trends and land use development under the alternatives.

Plan and Policy Consistency

The evaluation of plan and policy consistency will present the following information:

- ✱ Evaluation of the proposed policy in relation to its conformance with plans, policies, ordinances, and programs including, but not limited to:
 - ✱ City of Sacramento General Plan
 - ✱ City of Sacramento Emergency Evacuation Plan
 - ✱ County of Sacramento General Plan
 - ✱ South Natomas Community Plan
 - ✱ North Natomas Community Plan
 - ✱ Executive Order 11988, Flood Plain Management
 - ✱ FHA/VA Home Loan Programs
 - ✱ Federal Emergency Management Agency Regulations

- ✱ U.S. Army Corps of Engineers Flood Plain Regulatory Programs
- ✱ Other related Federal, State, Regional, County, and City Plans

Public Health and Safety

- ✱ Hazard Identification:

The first step in the computation will be to more precisely define the hazard and how it might occur. Flood hazard could occur in a number of ways; overtopping of the levees, sudden failure of a levee in a single location or multiple levee failures are examples. The most probable hazard scenarios will be developed and one to three selected for detailed analysis. Their frequency of occurrence will be estimated based on Corps of Engineers data and other studies.

- ✱ Exposure Analysis:

The exposure of the population to flood hazard under each of the hazard scenarios will be estimated. Number of individuals exposed will be calculated together with the severity of the exposure. The severity of exposure will depend on depth of flooding, suddenness of the event and access to evacuation and rescue services. Estimates of property damage and loss of life will be made based on a review of other similar hazardous incidents and Corps of Engineers calculations.

- ✱ Risk Calculation:

Risk estimates will be made for each alternative. One alternative would assume no further development in the flood plain until the levees are strengthened. Another would assume implementation of the proposed project -- the new land use planning policy for the 100-year flood plain. Risk of death by flooding per year will be calculated for each alternative. The differences between the alternatives will provide information on the incremental risk associated with the proposed project. Similar calculations will be made for property damage.

Cumulative Impacts

The cumulative impact analysis will provide a comparison of the increase in impacts associated with the proposed land use policy with the existing conditions of development within the 100-year flood plain. The primary intent of this analysis will be to describe the incremental increase in flood associated impacts due to development which would occur with the project, or any alternatives.

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Sacramento Public Works
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Sacramento, CA 95822-2911

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Room 2N003
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PG&E
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Mary Benard
Windwood Homeowners
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Dianne Smith
Valley Hi Comm. Assoc.
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Sacramento, CA 95823

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Strawberry Manor
Neighborhood Assoc.
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Sacramento, CA 95838

Downtown Neighborhood Assoc.
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Sacramento, CA 95818

Jonel Jorgensen
Southside Neighborhood Comm.
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Sacramento, CA 95816

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Franchise of Americans
Needing Sports
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Capitol Bicycle Commission
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Sacramento, CA 95814

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Lung Association
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California Native Plant
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Sierra Club
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Toxic Alliance
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SARA
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Planning & Conservation League
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Daniel Yamshon
SCOLD
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Sacramento, CA 95816

Tina Thomas
Farms in Our Future
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Sacramento, CA 95814

Paget Leh
National Marine Fishery
Services
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Sacramento, CA 94920

John Harvey Carter
Save Open Space Committee
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Sacramento, CA 95814

Jim Sanders
Sacramento Bee
P.O. Box 15779
Sacramento, CA 95813

Lew Phalen
Sacramento Union
301 Capitol Mall
Sacramento, CA 95812

Mike McCarthy
The Business Journal
2030 "J" Street
Sacramento, CA 95814

Tim Hoyt
Suttertown News
2791 24th Street, Rm 16
Sacramento, CA 95818

Neighbors Section
3628 Madison Ave., Suite 3
North Highlands, CA 95660

APPENDIX C

RESPONSES TO NOTICE OF PREPARATION

DEPARTMENT OF FISH AND GAME

REGION 2
1701 NIMBUS ROAD, SUITE A
RANCHO CORDOVA, CALIFORNIA 95670
(916) 355-7020



RECEIVED
AUG 1 1989
Planning and Development
August 10, 1989

Ms. Barbara Wendt
City of Sacramento
Department of Planning and Development
1231 I Street, Room 300
Sacramento, CA 95814-2998

Dear Ms. Wendt:

The Department of Fish and Game (DFG) has reviewed the City of Sacramento's Notice of Preparation of a Draft Environmental Impact Report (EIR) for a project which has been defined as the Land Use Planning Policy for the 100-year flood plain for areas within the City and County of Sacramento that are identified on the preliminary Federal Emergency Management Agency Flood Insurance Map and the Sacramento River Levee Failure Flood Potential Map (see attached maps).

The DFG recommends the EIR discuss and mitigate the project's impact upon the following:

1. The project's potential impact upon wetlands. The study area should be surveyed by a qualified botanist for wetlands. All wetlands should be identified and policy(s) developed to protect them. If any wetlands are to be unavoidably impacted, mitigation should be provided that is based upon the concept of no net loss of wetland habitat values or acreage.
2. The study area should be surveyed by qualified botanist and biologist for any State- or Federal-listed rare, threatened, or endangered plants or animals. If any are found that may be adversely impacted, mitigation measures (policies) should be provided to protect them. The plan should provide criteria for protection of stream corridors and adjacent habitats for fisheries, wildlife, and water quality protection.

In order to comply with Public Resources Code Section 21081.6, a detailed monitoring program must be developed for all required mitigation conditions. The monitoring program should include the following:

- a. Specific criteria to measure effectiveness of mitigation.
- b. Annual monitoring for a minimum of five years. Annual written reports submitted to the lead agency and the DFG.

Ms. Barbara Wendt

-2-

- c. Annual monitoring reports, each of which include corrective recommendations that shall be implemented in order to ensure that mitigation efforts are successful.

The EIR should include a statement that pursuant to Fish and Game Code Section 1600 et seq., it will be necessary to obtain a Streambed Alteration Agreement with the DFG prior to work within the 100-year flood plain of any waterway. The notification (with fee), and subsequent agreement, must be completed prior to initiating any such work. Notification to the DFG should be made after the project is approved by the lead agency. The agreement should not be used in lieu of appropriate mitigation included in the final conditions of approval.

If we can be of further assistance, please contact Mr. Bob Mapes, Associate Wildlife Biologist, or Ms. Patricia Perkins, Wildlife Management Supervisor, telephone (916) 355-7010.

Sincerely,




James D. Messersmith
Regional Manager

Attachment

FIGURE 1

LEGEND:

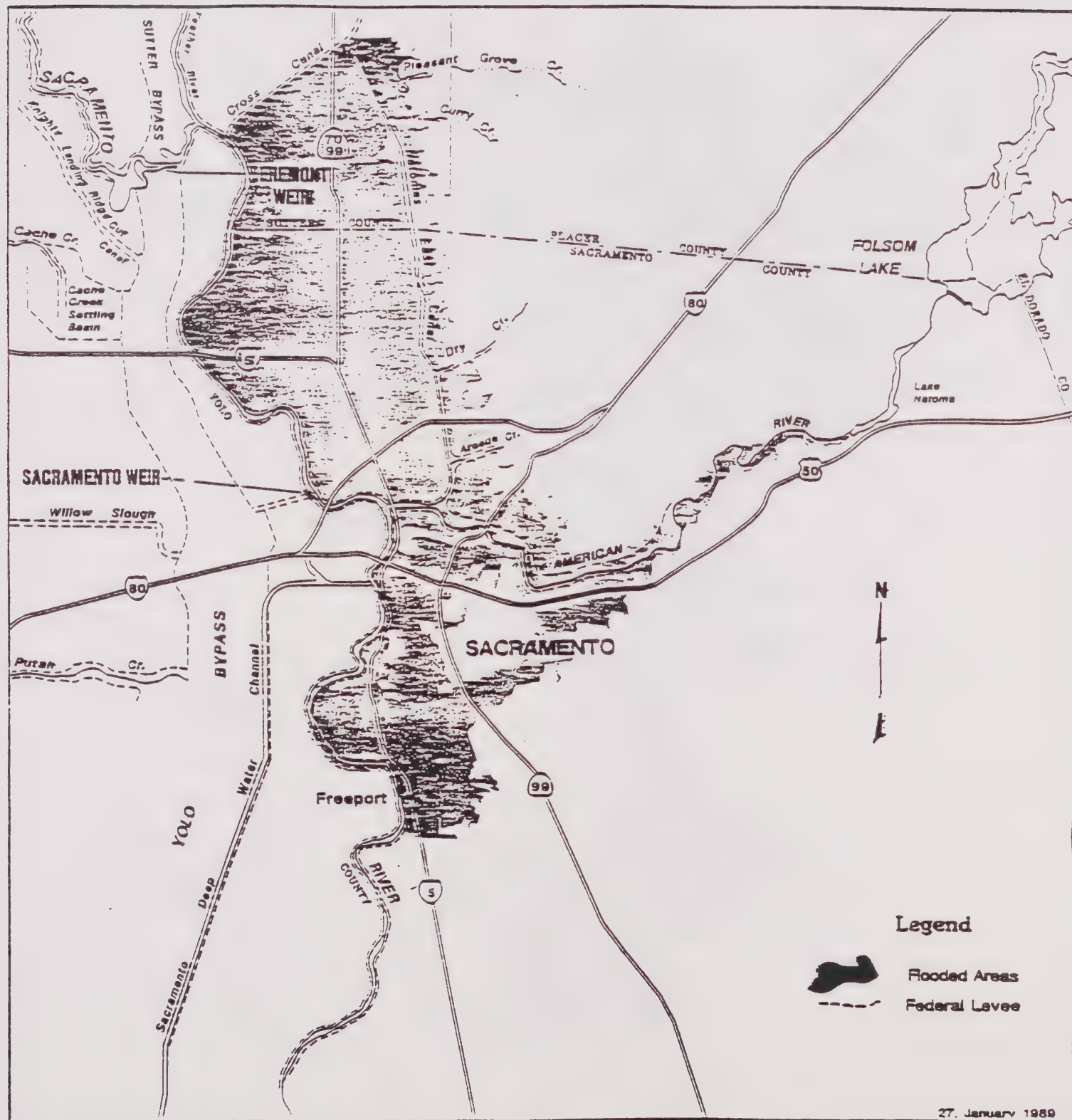
 SACRAMENTO RIVER FLOOD DAMAGE
WHERE REMEDIAL LEVEE REPAIRS
REQUIRED



SACRAMENTO RIVER
LEVEE FAILURE
FLOOD POTENTIAL
CITY OF SACRAMENTO

PROPOSED 100-YEAR FLOOD PLAIN FOR
THE SACRAMENTO AND AMERICAN RIVERS
(Based on the January 1989 FEMA Working Map)

FIGURE 2



APPENDIX D

*DETAILED METHDOLOGY FOR PROJECTION OF POPULATION,
HOUSING, AND NON-RESIDENTIAL DEVELOPMENT*

Subarea Boundaries



Flood Zone Continues
Eastward to Nimbus Dam



Source: EIP Associates, 1989



APPENDIX E

*DETAILED METHODOLOGY FOR PROJECTION
OF PROPERTY DAMAGE*

APPENDIX E

CALCULATIONS FOR IMPACTS OF FLOODING ON PROPERTY

Growth to 2010 was projected as previously described, for housing units and for square feet of retail and non-retail (non-residential) structures. The value of property was estimated using the following standard factors for the value of structures and contents:

RESIDENTIAL STRUCTURES SINGLE FAMILY

Value of Structures: Average house price in July, 1989
\$130,132
(Source: Sacramento County Board of Realtors)

Single-family units include duplexes and single-family attached units.

Value of Contents: 75% of value of structure
(Source: Allstate Insurance, Farmer's Insurance, FEMA)

MULTI-FAMILY

Value of Structures: \$25 to \$125 per SF (\$75/SF, the midpoint of the range, was used)
(Source: Sacramento County Assessor's Office)

The average multi-family unit was assumed to be 1,000 SF, which was assumed to include common areas. Each unit, therefore, was assumed on the average to be valued at \$35,000.

Value of Contents: \$30,000 to \$40,000 per unit
(Source: Farmer's Insurance)

The midpoint of the range, \$35,000, was used

The following table shows the distribution of single and multi-family units by Planning Area.

| Community | Existing MF-% | 89-92 Increment MF-% | 92-95 Increment MF-% | 95-BO Increment MF-% |
|--------------------|------------------|----------------------------|----------------------------|----------------------------|
| N. Natomas | 1% | 20% | 0% | 58% |
| S. Natomas | 42% | 13% | 0% | 0% |
| N. Sacramento | 27% | 34% | 34% | 31% |
| Airport/Meadowview | 19% | 35% | 37% | 21% |
| Pocket | 35% | 12% | 12% | 0% |
| S. Sacramento | 26% | 31% | 32% | 44% |
| Arden/Arcade | 54% | 0% | 0% | 0% |
| Central City | 85% | 92% | 94% | 87% |
| E. Broadway | 21% | 35% | 34% | 17% |
| E. Sacramento | 29% | 0% | 0% | 0% |
| Land Park | 23% | 0% | 0% | 0% |
| City Total | 36% | 30% | 30% | 43% |

(Source: City of Sacramento Planning Projections, 1989)

NON-RESIDENTIAL STRUCTURES

Value of Structures:

Steel Construction/Fireproof(A):

\$50 to \$200 per SF

Steel Girder Construction (B):

\$50 to \$200 per SF

Concrete Block or Tilt Construction (C):

\$15 to \$70 per SF

Wood Frame Construction (D):

\$25 to \$125 per SF

It was assumed that the middle of the range would be used for non-residential square-foot dollar values (Source: Sacramento County Assessor's Office).

Other assumptions included:

- All residential structures are wood frame;
- Regional malls, such as Arden Fair or Sunrise are generally B Construction;
- Other retail centers are generally C or D construction;

- Office buildings over 2 stories are A or B, under 2 stories, are D; and
- Industrial/warehouse buildings are primarily C construction.

Value of Contents: 100% to 150% of value of structure
 Tenant Improvements: 20% of value of structure.
 (Source: U.S.COE, 1989)

The following table shows the distribution of non-retail development by planning area.

| Community | Existing %Non-retail | Projected %Non-retail |
|--------------------|-------------------------|--------------------------|
| N. Natomas | 0% | 19% |
| S. Natomas | 100% | 91% |
| N. Sacramento | 17% | 5% |
| Airport/Meadowview | 66% | 42% |
| Pocket | 100% | 100% |
| S. Sacramento | 12% | 5% |
| Arden/Arcade | 65% | 67% |
| Central City | 46% | 2% |
| E. Broadway | 7% | 11% |
| E. Sacramento | 28% | 16% |
| Land Park | 35% | 0% |
| City Total | 28% | 21% |

(Source: City of Sacramento General Plan, 1989)

The percent damage to structures was estimated using depth-damage curves derived from tables formulated by the U.S. COE for their May 1988, "Sacramento River Flood Control System Evaluation Initial Appraisal Report-Sacramento Urban Area." The depth-damage curves relate the percent of structures and contents damaged at specified depths.

Average flood depth for each subarea was derived based on information received from the U.S. COE (Sibilsky and Yarwood, 1989); "Imminent/Actual Flooding Conditions (Levee Overtopping/Failure) Natomas Area" (City of Sacramento); "Summary Report, Time Inundation Study Pocket Area" (City of Sacramento); and elevation and floodflow levels off the January 1989 Working Maps.

Depth was generalized for each subarea, as described above, and the impacts aggregated for the entire study area. Effects of flooding would be greater in the Natomas and Pocket areas than in other areas. Effects of flooding on property was assumed to be greater in the Natomas area, as the level of flood protection in that area is currently 40-year protection. The Pocket Area and the remaining flood plain area have 63-year level of flood protection, and so effects of flooding on property in the Pocket Area would be similar to those in the rest of the study area. For this reason, impacts in Natomas were discussed separately, but impacts in the study area as a whole were discussed in the aggregate.

**DAMAGE TO PROPERTY DUE TO 100-YEAR FLOOD
STRUCTURES AND CONTENTS**
In Millions of (1989) Dollars

| Type of Structure | Existing 1988 | 1989-1992 Growth Increment | 1992 Total | 1992-1997 Growth Increment | 1997 Total | 1997-2010 Growth Increment | 2010 Total | Annual Growth Increment ¹ |
|-----------------------------------|------------------|----------------------------------|---------------|----------------------------------|---------------|----------------------------------|---------------|--|
| <u>Natomas</u> | | | | | | | | |
| Residential | \$2,994 | \$337 | \$3,331 | \$210 | \$3,541 | \$5,214 | \$8,755 | \$401 |
| Non-Residential | | | | | | | | |
| Retail | 91 | 14 | 105 | 8 | 113 | 318 | 431 | 24 |
| Non-Retail | 530 | 150 | 680 | 86 | 765 | 3,447 | 4,212 | 265 |
| Total Non-Residential | <u>621</u> | <u>164</u> | <u>785</u> | <u>94</u> | <u>878</u> | <u>3,765</u> | <u>4,643</u> | <u>289</u> |
| Total Damage | \$3,615 | \$501 | \$4,116 | \$304 | \$4,419 | \$8,979 | \$13,398 | \$690 |
| <u>The Pocket Area</u> | | | | | | | | |
| Residential | \$3,037 | \$170 | \$3,208 | \$72 | \$3,279 | \$220 | \$3,499 | \$17 |
| Non-Residential | | | | | | | | |
| Retail | 92 | 12 | 104 | 16 | 120 | 39 | 159 | 3 |
| Non-Retail | 276 | 71 | 347 | 89 | 436 | 232 | 668 | 18 |
| Total Non-Residential | <u>368</u> | <u>83</u> | <u>451</u> | <u>105</u> | <u>556</u> | <u>271</u> | <u>827</u> | <u>21</u> |
| Total Damage | 3,405 | \$253 | \$3,659 | \$177 | \$3,835 | \$491 | \$4,326 | \$38 |
| <u>Remaining Flood Plain Area</u> | | | | | | | | |
| Residential | \$17,865 | \$1,361 | \$19,224 | \$807 | \$20,032 | \$4,558 | \$24,620 | \$353 |
| Non-Residential | | | | | | | | |
| Retail | 2,053 | 207 | 2,260 | 291 | 2,551 | 420 | 2,971 | 32 |
| Non-Retail | 6,993 | 1,323 | 8,316 | 1,542 | 9,859 | 3,203 | 13,062 | 100 |
| Total Non-Residential | <u>9,046</u> | <u>1,530</u> | <u>10,576</u> | <u>1,833</u> | <u>12,410</u> | <u>3,623</u> | <u>16,033</u> | <u>132</u> |
| Total Damage | \$26,911 | \$2,891 | \$29,800 | \$2,640 | \$32,442 | \$8,211 | \$40,653 | \$485 |
| <u>Total Flood Plain</u> | | | | | | | | |
| Residential | \$23,896 | \$1,868 | \$25,763 | \$1,089 | \$26,852 | \$10,022 | \$36,874 | \$771 |
| Non-Residential | | | | | | | | |
| Retail | 2,236 | 233 | 2,469 | 315 | 2,784 | 777 | 3,561 | 59 |
| Non-Retail | 7,799 | 1,544 | 9,345 | 1,717 | 11,060 | 6,882 | 17,942 | 383 |
| Total Non-Residential | <u>10,035</u> | <u>1,777</u> | <u>11,812</u> | <u>2,032</u> | <u>13,844</u> | <u>7,659</u> | <u>21,503</u> | <u>442</u> |
| Total Damage | \$33,931 | \$3,645 | \$37,575 | \$3,121 | \$40,696 | \$17,681 | \$58,377 | \$1,213 |

¹ Annual increment for each year after 1997 to 2010 if no improvements are implemented.
SOURCE: EIP Associates

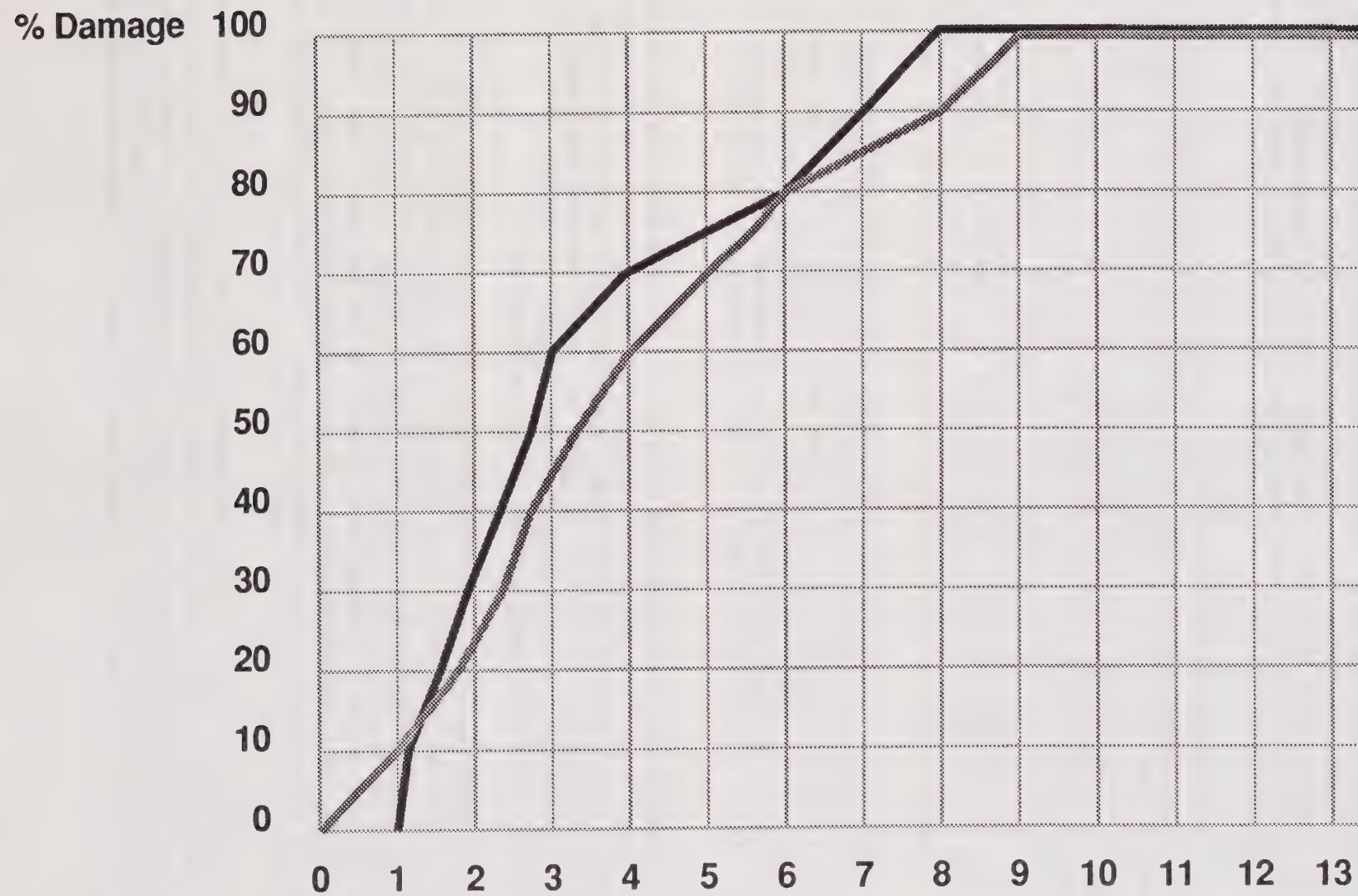
RELATIONSHIP OF DEPTH TO DAMAGE

| Depth in Feet | % Damage to Structure | % Damage to Contents |
|------------------|--------------------------|-------------------------|
| 1 | 8 | 0 |
| 2 | 26 | 35 |
| 3 | 45 | 60 |
| 4 | 60 | 70 |
| 5 | 70 | 75 |
| 6 | 80 | 80 |
| 7 | 85 | 90 |
| 8 ^a | 100 | 100 |
| 9 | 100 | 100 |

^a After a depth of 8 feet 100% damage is incurred for both structures and contents.

Source: U.S. COE; EIP Associates, 1989

Damage-Depth Curves



Building Contents ———
Building Structure ·····

Source: USCOE,
EIP Associates, 1989

ECONOMICS APPENDIX

The following information is intended to supplement the data already presented and should provide a better understanding of how the benefits were computed.

Flood plains were delineated on quad sheets for the Natomas, South Sacramento, and West Sacramento areas. The Natomas flood plain is based on the assumption that the area will be inundated as a result of levee failure in a 40-year frequency event, while, the flood plains for the South Sacramento and West Sacramento areas show that these areas would be inundated with a 90-year frequency event. Both of these frequencies of failure assumptions were considered to be without project conditions for purposes of economic analysis.

An inventory by structure type (e.g. residential, commercial, industrial) was not undertaken because of the large amount of developed acreage involved and because the level of detail did not seem to be warranted for this type of project (levee rehabilitation to modify an already completed project). The Sacramento County Assessor's rolls were used instead to determine the value of private damageable property in the flood plains. There was one problem with this approach because of the effects of the passage of Proposition 13. However, the problem was resolved after consultation with the Assessor's office. It was decided that a 37% increase of adjustment in damageable property values would more properly reflect the true market values for the area. Content value for all structures was placed at 50% of structure value.

Depth-damage relationships were based upon the FIA depth-damage curves (structures and contents were analyzed independently), and adjusted for an average foundation height of 1 foot for private structures. The reason for using the 1 foot height was to achieve a balance between those structures on slabs (0.5') and those with the first floor elevated at a higher level (e.g. 1.5'). This is a critical element in the determination of damages to contents.

An additional adjustment was made in the Natomas and West Sacramento depth-damage curves to account for duration. The increase in the percent of damages anticipated to occur at each depth was based upon the flooding that occurred in Isleton, California in 1972 and flood damages associated with that event. Attachments 1 and 2 show how the damages for private structures were calculated for the Natomas and West Sacramento areas.

West Sacramento was actually divided into two sub-areas with the Sacramento River Deep Water Ship Channel acting as a dividing line. A 90-year levee failure could occur in either area with depths of flooding varying in each sub-area depending upon where the break occurs. In either situation, a levee failure in one sub-area would result in the adjacent area being flooded. For purposes of economic analysis, it was assumed that there was a 50 percent chance of a break occurring in each sub-area. The damages presented in the main report are therefore an average of the two sub-areas.

Attachment 3 shows the damage computation for private structures in the South Sacramento area. The depth-damage relationships were not adjusted for duration of flooding because more detailed hydrographic information would be needed to identify specific areas with a duration problem and the length of that duration. Standard FIA curves were assumed to be appropriate at this time.

Estimates of the flood losses were also made for the following categories: public and semi-public; traffic re-routing; levee repair; emergency costs and agriculture. Public and semi-public damageable property values were based on a recent Corps study in the South Sacramento area ("Report on Phase I, Advance Engineering and Design, Morrison Creek Stream Group, California", U.S. Army Corps of Engineers, Sacramento District, March 1987). The public and semi-public acres within the flood plains were measured (4390-Natomas; 1049-South Sacramento; and 1020-West Sacramento), and then they were multiplied by their value per acre. The value per acre depended upon the stage of development of that acre (whether it was a school or park for example). The relationship of private damages to value of property was then used to determine the amount of public damages (see Attachment 4). Traffic re-routing was only considered on the major freeways (I-5 and Highway 99). Emergency costs were based on the cost of \$35 per person/day depending upon both duration of flooding and the anticipated time it would take before a family could move safely back into their home. Agriculture damages were minimal and the damages only amounted to about \$50/acre.

AMERICAN RIVER
AREA 1 - NATOMAS
1985 / 1986

75 & 200 YEAR FLOOD EVENT
(South of Cross Canal & North of American River)

| BOOK | PAGE | BK/PG% | BK/PGVA | (%)(VAL)) | %INCR | MKT VALUE | DEPTH | %DAM STRU | STRU DAM | %DAM CONT | CONT DAM | TOTAL |
|-------|------|--------|---------|-----------|-------|--------------|-------|--------------|-------------|--------------|-------------|----------|
| 35 | | 65 | 16181 | 10517.65 | 1.37 | 1.44E+4 | 8 | 90 | 12968.26 | 100 | 7204.59 | 20172.85 |
| 201 | 6 | 100 | 9149 | 9149 | 1.37 | 1.25E+4 | 7 | 85 | 10654.01 | 90 | 5640.36 | 16294.37 |
| | 7 | 100 | 204 | 204 | 1.37 | 279.48 | 7 | 85 | 237.56 | 90 | 125.77 | 363.32 |
| | 10 | 100 | 0 | 0 | 1.37 | 0 | 8 | 90 | 0 | 100 | 0 | 0 |
| 225 | | 100 | 361162 | 361162 | 1.37 | 4.95E+5 | 10 | 100 | 4.95E+5 | 100 | 2.47E+5 | 7.42E+5 |
| 274 | 19 | 100 | 1333 | 1333 | 1.37 | 1826.21 | 10 | 100 | 1826.21 | 100 | 913.11 | 2739.32 |
| | 20 | 100 | 1230 | 1230 | 1.37 | 1685.10 | 10 | 100 | 1685.10 | 100 | 842.55 | 2527.65 |
| | 21 | 100 | 882 | 882 | 1.37 | 1208.34 | 10 | 100 | 1208.34 | 100 | 604.17 | 1812.51 |
| TOTAL | | | 390141 | 384477.65 | | 5.27E+5 | | | 5.23E+5 | | 2.63E+5 | 7.86E+5 |

* IN 1,000'S

AMERICAN RIVER
AREA 6 - WEST SACRAMENTO
1985 / 1986
FLOOD ELEVATION 19'

| BOOK | PAGE | BK/PG% | BK/PGV | (%)(VAL) | %INCR | MKT VALUE | ELEV. | DEPTH | %DAM STRU | STRU DAM | %DAM CONT | CONT DAM | TOTAL |
|------|------|--------|--------|----------|-------|--------------|-------|-------|--------------|-------------|--------------|-------------|----------|
| 8 | 1 | 100 | 493 | 493 | 1.37 | 675.41 | 6 | 13 | 100 | 675.41 | 100 | 337.71 | 1013.12 |
| 8 | 2 | 100 | 671 | 671 | 1.37 | 919.27 | 6 | 13 | 100 | 919.27 | 100 | 459.64 | 1378.91 |
| 8 | 3 | 100 | 6738 | 6738 | 1.37 | 9231.06 | 10 | 9 | 100 | 9231.06 | 100 | 4615.53 | 13846.59 |
| 8 | 5 | 100 | 604 | 604 | 1.37 | 827.48 | 14 | 5 | 70 | 579.24 | 75 | 310.31 | 889.54 |
| 8 | 6 | 100 | 922 | 922 | 1.37 | 1263.14 | 14 | 5 | 70 | 884.20 | 75 | 473.68 | 1357.88 |
| 8 | 8 | 100 | 2981 | 2981 | 1.37 | 4033.97 | 16 | 3 | 45 | 1837.79 | 60 | 1225.19 | 3062.98 |
| 8 | 10 | 100 | 1868 | 1868 | 1.37 | 2586.56 | 16 | 3 | 45 | 1163.95 | 60 | 775.97 | 1939.92 |
| 8 | 11 | 100 | 2504 | 2504 | 1.37 | 3430.48 | 16 | 3 | 45 | 1543.72 | 60 | 1029.14 | 2572.86 |
| 8 | 13 | 100 | 1424 | 1424 | 1.37 | 1950.88 | 16 | 3 | 45 | 877.90 | 60 | 585.26 | 1463.16 |
| 8 | 14 | 100 | 4175 | 4175 | 1.37 | 5719.75 | 16 | 3 | 45 | 2573.89 | 60 | 1715.93 | 4289.81 |
| 8 | 15 | 100 | 1794 | 1794 | 1.37 | 2457.78 | 18 | 1 | 8 | 196.62 | 0 | 0 | 196.62 |
| 8 | 19 | 100 | 1398 | 1398 | 1.37 | 1915.26 | 16 | 3 | 45 | 861.87 | 60 | 574.58 | 1436.45 |
| 8 | 20 | 100 | 2002 | 2002 | 1.37 | 2742.74 | 16 | 3 | 45 | 1234.23 | 60 | 822.82 | 2057.06 |
| 8 | 21 | 100 | 2603 | 2603 | 1.37 | 3566.11 | 16 | 3 | 45 | 1604.75 | 60 | 1069.83 | 2674.58 |
| 8 | 22 | 100 | 4552 | 4552 | 1.37 | 6236.24 | 17 | 2 | 26 | 1621.42 | 35 | 1091.34 | 2712.76 |
| 8 | 29 | 100 | 2467 | 2467 | 1.37 | 3379.79 | 16 | 3 | 45 | 1520.91 | 60 | 1013.94 | 2534.84 |
| 8 | 30 | 100 | 1025 | 1025 | 1.37 | 1404.25 | 16 | 3 | 45 | 631.91 | 60 | 421.28 | 1053.19 |
| 8 | 31 | 100 | 1512 | 1512 | 1.37 | 2071.44 | 16 | 3 | 45 | 932.15 | 60 | 621.43 | 1553.58 |
| 8 | 32 | 100 | 1785 | 1785 | 1.37 | 2445.45 | 16 | 3 | 45 | 1100.45 | 60 | 733.64 | 1834.09 |
| 8 | 33 | 100 | 679 | 679 | 1.37 | 930.23 | 16 | 3 | 45 | 418.60 | 60 | 279.07 | 697.67 |
| 8 | 35 | 100 | 1763 | 1763 | 1.37 | 2415.31 | 16 | 3 | 45 | 1086.89 | 60 | 724.59 | 1811.48 |
| 8 | 36 | 100 | 1345 | 1345 | 1.37 | 1842.65 | 15 | 4 | 60 | 1105.59 | 70 | 644.93 | 1750.52 |
| 8 | 37 | 100 | 1403 | 1403 | 1.37 | 1922.11 | 15 | 4 | 60 | 1153.27 | 70 | 672.74 | 1826.00 |
| 8 | 38 | 100 | 717 | 717 | 1.37 | 982.29 | 14 | 5 | 70 | 687.60 | 75 | 368.36 | 1055.96 |
| 8 | 39 | 100 | 748 | 748 | 1.37 | 1024.76 | 16 | 3 | 45 | 461.14 | 60 | 307.43 | 768.57 |
| 8 | 40 | 100 | 741 | 741 | 1.37 | 1015.17 | 14 | 5 | 70 | 710.62 | 75 | 380.69 | 1091.31 |
| 8 | 41 | 100 | 779 | 779 | 1.37 | 1067.23 | 14 | 5 | 70 | 747.06 | 75 | 400.21 | 1147.27 |
| 8 | 42 | 100 | 1035 | 1035 | 1.37 | 1417.95 | 14 | 5 | 70 | 992.57 | 75 | 531.73 | 1524.30 |
| 8 | 43 | 100 | 601 | 601 | 1.37 | 823.37 | 16 | 3 | 45 | 370.52 | 60 | 247.01 | 617.53 |
| 8 | 44 | 100 | 993 | 993 | 1.37 | 1360.41 | 16 | 3 | 45 | 612.18 | 60 | 408.12 | 1020.31 |
| 8 | 45 | 100 | 479 | 479 | 1.37 | 656.23 | 16 | 3 | 45 | 295.30 | 60 | 196.87 | 492.17 |
| 8 | 46 | 100 | 573 | 573 | 1.37 | 785.01 | 16 | 3 | 45 | 353.25 | 60 | 235.50 | 588.76 |
| 8 | 47 | 100 | 2641 | 2641 | 1.37 | 3618.17 | 16 | 3 | 45 | 1628.18 | 60 | 1085.45 | 2713.63 |
| 8 | 48 | 100 | 2119 | 2119 | 1.37 | 2903.03 | 16 | 3 | 45 | 1306.36 | 60 | 870.91 | 2177.27 |
| 8 | 49 | 100 | 945 | 945 | 1.37 | 1294.65 | 14 | 5 | 70 | 906.26 | 75 | 485.49 | 1391.75 |
| 10 | 10 | 100 | 270 | 270 | 1.37 | 369.90 | 16 | 3 | 45 | 166.46 | 60 | 110.97 | 277.43 |
| 10 | 19 | 100 | 537 | 537 | 1.37 | 735.69 | 16 | 3 | 45 | 331.06 | 60 | 220.71 | 551.77 |
| 10 | 32 | 100 | 1656 | 1656 | 1.37 | 2268.72 | 18 | 1 | 8 | 181.50 | 0 | 0 | 181.50 |
| 10 | 34 | 100 | 503 | 503 | 1.37 | 689.11 | 18 | 1 | 8 | 55.13 | 0 | 0 | 55.13 |
| 10 | 37 | 100 | 149 | 149 | 1.37 | 204.13 | 26 | 0 | 0 | 0 | 0 | 0 | 0 |
| 10 | 40 | 100 | 1395 | 1395 | 1.37 | 1911.15 | 16 | 3 | 45 | 860.02 | 60 | 573.35 | 1433.36 |
| 10 | 41 | 100 | 731 | 731 | 1.37 | 1001.47 | 16 | 3 | 45 | 450.66 | 60 | 300.44 | 751.10 |
| 10 | 42 | 100 | 858 | 858 | 1.37 | 1175.46 | 28 | 0 | 0 | 0 | 0 | 0 | 0 |
| 10 | 43 | 100 | 931 | 931 | 1.37 | 1275.47 | 18 | 1 | 8 | 102.04 | 0 | 0 | 102.04 |
| 10 | 44 | 100 | 241 | 241 | 1.37 | 330.17 | 18 | 1 | 8 | 26.41 | 0 | 0 | 26.41 |
| 10 | 45 | 100 | 266 | 266 | 1.37 | 364.42 | 18 | 1 | 8 | 29.15 | 0 | 0 | 29.15 |
| 10 | 46 | 100 | 2355 | 2355 | 1.37 | 3226.35 | 18 | 1 | 8 | 258.11 | 0 | 0 | 258.11 |
| 10 | 47 | 100 | 652 | 652 | 1.37 | 893.24 | 0 | 19 | 100 | 893.24 | 100 | 446.62 | 1339.86 |
| 10 | 48 | 100 | 1857 | 1857 | 1.37 | 2544.09 | 18 | 1 | 8 | 203.53 | 0 | 0 | 203.53 |

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| BOOK | PAGE | BK/PG% | BK/PGV | (%)(VAL) | %INCR | MKT VALUE | ELEV. | DEPTH | %DAM STRU | STRU DAM | %DAM CONT | CONT DAM | TOTAL |
|------|------|--------|--------|----------|-------|--------------|-------|-------|--------------|-------------|--------------|-------------|---------|
| 10 | 49 | 100 | 1037 | 1037 | 1.37 | 1420.69 | 20 | 0 | 0 | 0 | 0 | 0 | 0 |
| 10 | 50 | 100 | 1560 | 1560 | 1.37 | 2137.20 | 18 | 1 | 8 | 170.98 | 0 | 0 | 170.98 |
| 10 | 51 | 100 | 936 | 936 | 1.37 | 1282.32 | 18 | 1 | 8 | 102.59 | 0 | 0 | 102.59 |
| 10 | 52 | 100 | 1270 | 1270 | 1.37 | 1739.90 | 18 | 1 | 8 | 139.19 | 0 | 0 | 139.19 |
| 10 | 53 | 100 | 0 | 0 | 1.37 | 0 | 18 | 1 | 8 | 0 | 0 | 0 | 0 |
| 14 | 3 | 100 | 866 | 866 | 1.37 | 1186.42 | 20 | 0 | 0 | 0 | 0 | 0 | 0 |
| 14 | 4 | 100 | 668 | 668 | 1.37 | 915.16 | 23 | 0 | 0 | 0 | 0 | 0 | 0 |
| 14 | 5 | 100 | 1167 | 1167 | 1.37 | 1593.79 | 17 | 2 | 26 | 415.69 | 35 | 279.79 | 695.47 |
| 14 | 6 | 100 | 1603 | 1603 | 1.37 | 2196.11 | 18 | 1 | 8 | 175.69 | 0 | 0 | 175.69 |
| 14 | 7 | 100 | 1558 | 1558 | 1.37 | 2134.46 | 20 | 0 | 0 | 0 | 0 | 0 | 0 |
| 14 | 8 | 100 | 727 | 727 | 1.37 | 993.99 | 22 | 0 | 0 | 0 | 0 | 0 | 0 |
| 14 | 9 | 100 | 614 | 614 | 1.37 | 841.18 | 16 | 3 | 45 | 379.53 | 60 | 252.35 | 630.89 |
| 14 | 10 | 100 | 1833 | 1833 | 1.37 | 2511.21 | 20 | 0 | 0 | 0 | 0 | 0 | 0 |
| 14 | 13 | 100 | 729 | 729 | 1.37 | 998.73 | 22 | 0 | 0 | 0 | 0 | 0 | 0 |
| 14 | 24 | 100 | 2270 | 2270 | 1.37 | 3109.90 | 18 | 1 | 8 | 248.79 | 0 | 0 | 248.79 |
| 14 | 25 | 100 | 2770 | 2770 | 1.37 | 3794.90 | 16 | 3 | 45 | 1707.71 | 60 | 1138.47 | 2846.18 |
| 14 | 26 | 100 | 2534 | 2534 | 1.37 | 3471.58 | 18 | 1 | 8 | 277.73 | 0 | 0 | 277.73 |
| 14 | 27 | 100 | 2137 | 2137 | 1.37 | 2927.69 | 16 | 3 | 45 | 1317.46 | 60 | 878.31 | 2195.77 |
| 14 | 28 | 100 | 2123 | 2123 | 1.37 | 2908.51 | 16 | 3 | 45 | 1308.83 | 60 | 872.55 | 2181.38 |
| 14 | 29 | 100 | 3262 | 3262 | 1.37 | 4468.94 | 16 | 3 | 45 | 2011.02 | 60 | 1340.68 | 3351.71 |
| 14 | 31 | 100 | 2297 | 2297 | 1.37 | 3146.89 | 16 | 3 | 45 | 1416.10 | 60 | 944.07 | 2360.17 |
| 14 | 32 | 100 | 2196 | 2196 | 1.37 | 3011.26 | 16 | 3 | 45 | 1355.07 | 60 | 903.38 | 2258.45 |
| 14 | 34 | 100 | 1023 | 1023 | 1.37 | 1404.25 | 16 | 3 | 45 | 631.91 | 60 | 421.22 | 1053.19 |
| 14 | 35 | 100 | 2942 | 2942 | 1.37 | 4030.54 | 16 | 3 | 45 | 1813.74 | 60 | 1209.16 | 3022.91 |
| 14 | 36 | 100 | 1199 | 1199 | 1.37 | 1642.63 | 18 | 1 | 8 | 131.41 | 0 | 0 | 131.41 |
| 14 | 37 | 100 | 5661 | 5661 | 1.37 | 7755.57 | 20 | 0 | 0 | 0 | 0 | 0 | 0 |
| 14 | 38 | 100 | 2913 | 2913 | 1.37 | 3990.81 | 20 | 0 | 0 | 0 | 0 | 0 | 0 |
| 14 | 46 | 100 | 600 | 600 | 1.37 | 822 | 18 | 1 | 8 | 65.76 | 0 | 0 | 65.76 |
| 14 | 47 | 100 | 292 | 292 | 1.37 | 400.04 | 16 | 3 | 45 | 180.02 | 60 | 120.01 | 300.03 |
| 14 | 48 | 100 | 262 | 262 | 1.37 | 358.94 | 18 | 1 | 8 | 28.72 | 0 | 0 | 28.72 |
| 14 | 49 | 100 | 827 | 827 | 1.37 | 1132.99 | 18 | 1 | 8 | 90.64 | 0 | 0 | 90.64 |
| 14 | 50 | 100 | 2304 | 2304 | 1.37 | 3156.48 | 18 | 1 | 8 | 252.52 | 0 | 0 | 252.52 |
| 14 | 53 | 100 | 1774 | 1774 | 1.37 | 2430.38 | 16 | 3 | 45 | 1093.67 | 60 | 729.11 | 1822.79 |
| 14 | 54 | 100 | 3077 | 3077 | 1.37 | 4215.49 | 16 | 3 | 45 | 1896.97 | 60 | 1264.65 | 3161.62 |
| 14 | 55 | 100 | 1323 | 1323 | 1.37 | 1812.51 | 16 | 3 | 45 | 815.63 | 60 | 543.75 | 1359.38 |
| 14 | 56 | 100 | 1891 | 1891 | 1.37 | 2590.67 | 16 | 3 | 45 | 1165.80 | 60 | 777.20 | 1943.00 |
| 14 | 57 | 100 | 688 | 688 | 1.37 | 942.56 | 16 | 3 | 45 | 424.15 | 60 | 282.77 | 706.92 |
| 14 | 58 | 100 | 0 | 0 | 1.37 | 0 | 22 | 0 | 0 | 0 | 0 | 0 | 0 |
| 14 | 59 | 100 | 257 | 257 | 1.37 | 352.09 | 18 | 1 | 8 | 28.17 | 0 | 0 | 28.17 |
| 14 | 60 | 100 | 33 | 33 | 1.37 | 45.21 | 16 | 3 | 45 | 20.34 | 60 | 13.56 | 33.91 |
| 14 | 61 | 100 | 33 | 33 | 1.37 | 45.21 | 26 | 0 | 0 | 0 | 0 | 0 | 0 |
| 14 | 62 | 100 | 17 | 17 | 1.37 | 23.29 | 27 | 0 | 0 | 0 | 0 | 0 | 0 |
| 14 | 63 | 100 | 510 | 510 | 1.37 | 698.70 | 20 | 0 | 0 | 0 | 0 | 0 | 0 |
| 14 | 64 | 100 | 1922 | 1922 | 1.37 | 2633.14 | 18 | 1 | 8 | 210.65 | 0 | 0 | 210.65 |
| 58 | 1 | 100 | 3148 | 3148 | 1.37 | 4312.76 | 20 | 0 | 0 | 0 | 0 | 0 | 0 |
| 58 | 2 | 100 | 634 | 634 | 1.37 | 868.58 | 20 | 0 | 0 | 0 | 0 | 0 | 0 |
| 58 | 3 | 100 | 2297 | 2297 | 1.37 | 3146.89 | 23 | 0 | 0 | 0 | 0 | 0 | 0 |
| 58 | 4 | 100 | 2045 | 2045 | 1.37 | 2801.65 | 18 | 1 | 8 | 224.13 | 0 | 0 | 224.13 |
| 58 | 5 | 100 | 2093 | 2093 | 1.37 | 2867.41 | 20 | 0 | 0 | 0 | 0 | 0 | 0 |

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| BOOK | PAGE | BK/PG% | BK/PGV | (%)(VAL) | %INCR | MKT VALUE | ELEV. | DEPTH | %DAM STRU | STRU DAM | %DAM CONT | CONT DAM | TOTAL |
|------|------|--------|--------|----------|-------|--------------|-------|-------|--------------|-------------|--------------|-------------|----------|
| 58 | 6 | 100 | 324 | 324 | 1.37 | 443.88 | 20 | 0 | 0 | 0 | 0 | 0 | 0 |
| 58 | 7 | 100 | 1624 | 1624 | 1.37 | 2224.88 | 20 | 0 | 0 | 0 | 0 | 0 | 0 |
| 58 | 8 | 100 | 1291 | 1291 | 1.37 | 1768.67 | 20 | 0 | 0 | 0 | 0 | 0 | 0 |
| 58 | 9 | 100 | 2460 | 2460 | 1.37 | 3370.20 | 18 | 1 | 8 | 269.62 | 0 | 0 | 269.62 |
| 58 | 10 | 100 | 1473 | 1473 | 1.37 | 2018.01 | 19 | 0 | 0 | 0 | 0 | 0 | 0 |
| 58 | 11 | 100 | 1650 | 1650 | 1.37 | 2260.50 | 18 | 1 | 8 | 180.84 | 0 | 0 | 180.84 |
| 58 | 12 | 100 | 4018 | 4018 | 1.37 | 5504.66 | 18 | 1 | 8 | 440.37 | 0 | 0 | 440.37 |
| 58 | 13 | 100 | 2956 | 2956 | 1.37 | 4049.72 | 16 | 3 | 45 | 1822.37 | 60 | 1214.92 | 3037.29 |
| 58 | 14 | 100 | 1133 | 1133 | 1.37 | 1552.21 | 14 | 5 | 70 | 1086.55 | 75 | 582.08 | 1668.63 |
| 58 | 15 | 100 | 1428 | 1428 | 1.37 | 1956.36 | 18 | 1 | 8 | 156.51 | 0 | 0 | 156.51 |
| 58 | 16 | 100 | 1671 | 1671 | 1.37 | 2289.27 | 18 | 1 | 8 | 183.14 | 0 | 0 | 183.14 |
| 58 | 17 | 100 | 997 | 997 | 1.37 | 1365.89 | 18 | 1 | 8 | 109.27 | 0 | 0 | 109.27 |
| 58 | 18 | 100 | 4147 | 4147 | 1.37 | 5681.39 | 16 | 3 | 45 | 2556.63 | 60 | 1704.42 | 4261.04 |
| 58 | 19 | 100 | 3065 | 3065 | 1.37 | 4199.05 | 18 | 1 | 8 | 335.92 | 0 | 0 | 335.92 |
| 58 | 20 | 100 | 1727 | 1727 | 1.37 | 2365.99 | 18 | 1 | 8 | 189.28 | 0 | 0 | 189.28 |
| 58 | 21 | 100 | 1990 | 1990 | 1.37 | 2726.30 | 20 | 0 | 0 | 0 | 0 | 0 | 0 |
| 58 | 22 | 100 | 1613 | 1613 | 1.37 | 2209.81 | 18 | 1 | 8 | 176.78 | 0 | 0 | 176.78 |
| 58 | 23 | 100 | 2502 | 2502 | 1.37 | 3427.74 | 16 | 3 | 45 | 1542.48 | 60 | 1028.32 | 2570.81 |
| 58 | 24 | 100 | 3260 | 3260 | 1.37 | 4466.20 | 16 | 3 | 45 | 2009.79 | 60 | 1339.86 | 3349.65 |
| 58 | 25 | 100 | 950 | 950 | 1.37 | 1301.50 | 14 | 5 | 70 | 911.05 | 75 | 488.06 | 1399.11 |
| 58 | 26 | 100 | 2684 | 2684 | 1.37 | 3677.08 | 28 | 0 | 0 | 0 | 0 | 0 | 0 |
| 58 | 27 | 100 | 2023 | 2023 | 1.37 | 2771.51 | 28 | 0 | 0 | 0 | 0 | 0 | 0 |
| 58 | 28 | 100 | 1832 | 1832 | 1.37 | 2509.84 | 28 | 0 | 0 | 0 | 0 | 0 | 0 |
| 58 | 29 | 100 | 423 | 423 | 1.37 | 579.51 | 22 | 0 | 0 | 0 | 0 | 0 | 0 |
| 58 | 30 | 100 | 355 | 355 | 1.37 | 486.35 | 20 | 0 | 0 | 0 | 0 | 0 | 0 |
| 58 | 31 | 100 | 1337 | 1337 | 1.37 | 1831.69 | 22 | 0 | 0 | 0 | 0 | 0 | 0 |
| 58 | 32 | 100 | 5715 | 5715 | 1.37 | 7829.55 | 28 | 0 | 0 | 0 | 0 | 0 | 0 |
| 58 | 33 | 100 | 4205 | 4205 | 1.37 | 5760.85 | 28 | 0 | 0 | 0 | 0 | 0 | 0 |
| 58 | 34 | 100 | 1663 | 1663 | 1.37 | 2278.31 | 28 | 0 | 0 | 0 | 0 | 0 | 0 |
| 58 | 35 | 100 | 10017 | 10017 | 1.37 | 13723.29 | 26 | 0 | 0 | 0 | 0 | 0 | 0 |
| 67 | 1 | 100 | 1246 | 1246 | 1.37 | 1707.02 | 10 | 9 | 100 | 1707.02 | 100 | 853.51 | 2560.53 |
| 67 | 2 | 100 | 19191 | 19191 | 1.37 | 26291.67 | 10 | 9 | 100 | 26291.67 | 100 | 13145.84 | 39437.51 |
| 67 | 3 | 100 | 9744 | 9744 | 1.37 | 13349.28 | 10 | 9 | 100 | 13349.28 | 100 | 6674.64 | 20023.92 |
| 67 | 4 | 100 | 48497 | 48497 | 1.37 | 66440.89 | 10 | 9 | 100 | 66440.89 | 100 | 33220.45 | 99661.34 |
| 67 | 5 | 100 | 46739 | 46739 | 1.37 | 64032.43 | 10 | 9 | 100 | 64032.43 | 100 | 32016.22 | 96048.65 |
| 67 | 6 | 100 | 2458 | 2458 | 1.37 | 3367.46 | 10 | 9 | 100 | 3367.46 | 100 | 1683.73 | 5051.19 |
| 67 | 7 | 100 | 2550 | 2550 | 1.37 | 3493.50 | 10 | 9 | 100 | 3493.50 | 100 | 1746.75 | 5240.25 |
| 67 | 8 | 100 | 1563 | 1563 | 1.37 | 2141.31 | 10 | 9 | 100 | 2141.31 | 100 | 1070.66 | 3211.97 |
| 67 | 9 | 100 | 1460 | 1460 | 1.37 | 2000.20 | 10 | 9 | 100 | 2000.20 | 100 | 1000.10 | 3000.30 |
| 67 | 10 | 100 | 4055 | 4055 | 1.37 | 5555.35 | 11 | 8 | 100 | 5555.35 | 100 | 2777.68 | 8333.03 |
| 67 | 11 | 100 | 0 | 0 | 1.37 | 0 | 10 | 9 | 100 | 0 | 100 | 0 | 0 |
| 67 | 12 | 100 | 1737 | 1737 | 1.37 | 2379.69 | 14 | 5 | 70 | 1665.78 | 75 | 892.38 | 2558.17 |
| 67 | 13 | 100 | 15539 | 15539 | 1.37 | 21288.43 | 10 | 9 | 100 | 21288.43 | 100 | 10644.22 | 31932.65 |
| 67 | 14 | 100 | 13898 | 13898 | 1.37 | 19040.26 | 12 | 7 | 85 | 16184.22 | 90 | 8568.12 | 24752.34 |
| 67 | 15 | 100 | 22527 | 22527 | 1.37 | 30861.99 | 12 | 7 | 85 | 26232.69 | 90 | 13887.90 | 40120.59 |
| 67 | 16 | 100 | 19078 | 19078 | 1.37 | 26136.86 | 14 | 5 | 70 | 18295.80 | 75 | 9801.32 | 28097.12 |
| 67 | 17 | 100 | 6722 | 6722 | 1.37 | 9209.14 | 14 | 5 | 70 | 6446.40 | 75 | 3453.43 | 9899.83 |
| 67 | 18 | 100 | 92 | 92 | 1.37 | 126.04 | 13 | 6 | 80 | 100.83 | 80 | 50.42 | 151.25 |
| 67 | 19 | 100 | 1671 | 1671 | 1.37 | 2289.27 | 14 | 5 | 70 | 1602.49 | 75 | 858.48 | 2460.97 |

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| BOOK | PAGE | BK/PG% | BK/PGV | (%)(VAL) | %INCR | MKT VALUE | ELEV. | DEPTH | %DAM STRU | STRU DAM | %DAM CONT | CONT DAM | TOTAL |
|-------|------|--------|--------|----------|-------|--------------|-------|-------|--------------|-------------|--------------|-------------|---------|
| 67 | 20 | 100 | 4335 | 4335 | 1.37 | 5938.95 | 14 | 5 | 70 | 4157.27 | 75 | 2227.11 | 6384.37 |
| 67 | 21 | 100 | 1260 | 1260 | 1.37 | 1726.20 | 12 | 7 | 85 | 1467.27 | 90 | 776.79 | 2244.06 |
| 67 | 22 | 100 | 1143 | 1143 | 1.37 | 1565.91 | 14 | 5 | 70 | 1096.14 | 75 | 587.22 | 1683.35 |
| 67 | 23 | 100 | 3473 | 3473 | 1.37 | 4758.01 | 16 | 3 | 45 | 2141.10 | 60 | 1427.40 | 3568.51 |
| 67 | 24 | 100 | 1324 | 1324 | 1.37 | 1813.88 | 16 | 3 | 45 | 816.25 | 60 | 544.16 | 1360.41 |
| 67 | 25 | 100 | 1472 | 1472 | 1.37 | 2016.64 | 16 | 3 | 45 | 907.49 | 60 | 604.99 | 1512.48 |
| 67 | 26 | 100 | 2133 | 2133 | 1.37 | 2922.21 | 16 | 3 | 45 | 1314.99 | 60 | 876.66 | 2191.66 |
| 67 | 27 | 100 | 2818 | 2818 | 1.37 | 3860.66 | 16 | 3 | 45 | 1737.30 | 60 | 1158.20 | 2895.50 |
| 67 | 28 | 100 | 835 | 835 | 1.37 | 1143.95 | 16 | 3 | 45 | 514.78 | 60 | 343.19 | 857.96 |
| 67 | 29 | 100 | 3520 | 3520 | 1.37 | 4822.40 | 16 | 3 | 45 | 2170.08 | 60 | 1446.72 | 3616.80 |
| 67 | 30 | 100 | 3830 | 3830 | 1.37 | 5247.10 | 18 | 1 | 8 | 419.77 | 0 | 0 | 419.77 |
| 67 | 31 | 100 | 2829 | 2829 | 1.37 | 3875.73 | 16 | 3 | 45 | 1744.08 | 60 | 1162.72 | 2906.80 |
| 67 | 32 | 100 | 3441 | 3441 | 1.37 | 4714.17 | 16 | 3 | 45 | 2121.38 | 60 | 1414.25 | 3535.63 |
| 67 | 33 | 100 | 1808 | 1808 | 1.37 | 2476.96 | 14 | 5 | 70 | 1733.87 | 75 | 928.86 | 2662.73 |
| TOTAL | | | 468947 | | | 6.42E+5 | | | | 3.81E+5 | | 2.02E+5 | 5.83E+5 |

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| BOOK | PAGE | BK/PG% | BK/PGV | (%)(VAL) | %INCR | MKT VALUE | ELEV. | DEPTH | %DAM STRU | STRU DAM | %DAM CONT | CONT DAM | TOTAL |
|------|------|--------|--------|----------|-------|--------------|-------|-------|--------------|-------------|--------------|-------------|----------|
| 8 | 1 | 100 | 493 | 493 | 1.37 | 675.41 | 6 | 16 | 100 | 675.41 | 100 | 337.71 | 1013.12 |
| 8 | 2 | 100 | 671 | 671 | 1.37 | 919.27 | 6 | 16 | 100 | 919.27 | 100 | 459.64 | 1378.91 |
| 8 | 3 | 100 | 6738 | 6738 | 1.37 | 9231.06 | 10 | 12 | 100 | 9231.06 | 100 | 4615.53 | 13846.59 |
| 8 | 5 | 100 | 604 | 604 | 1.37 | 827.48 | 14 | 8 | 90 | 744.73 | 100 | 413.74 | 1158.47 |
| 8 | 6 | 100 | 922 | 922 | 1.37 | 1263.14 | 14 | 8 | 90 | 1136.83 | 100 | 631.57 | 1768.40 |
| 8 | 8 | 100 | 2981 | 2981 | 1.37 | 4083.97 | 16 | 6 | 80 | 3267.18 | 80 | 1633.59 | 4900.76 |
| 8 | 10 | 100 | 1888 | 1888 | 1.37 | 2586.56 | 16 | 6 | 80 | 2069.25 | 80 | 1034.62 | 3103.87 |
| 8 | 11 | 100 | 2504 | 2504 | 1.37 | 3430.48 | 16 | 6 | 80 | 2744.38 | 80 | 1372.19 | 4116.58 |
| 8 | 13 | 100 | 1424 | 1424 | 1.37 | 1950.88 | 16 | 6 | 80 | 1560.70 | 80 | 780.35 | 2341.06 |
| 8 | 14 | 100 | 4175 | 4175 | 1.37 | 5719.75 | 16 | 6 | 80 | 4575.80 | 80 | 2287.90 | 6863.70 |
| 8 | 15 | 100 | 1794 | 1794 | 1.37 | 2457.78 | 18 | 4 | 60 | 1474.67 | 70 | 860.22 | 2334.89 |
| 8 | 19 | 100 | 1398 | 1398 | 1.37 | 1915.26 | 16 | 6 | 80 | 1532.21 | 80 | 766.10 | 2298.31 |
| 8 | 20 | 100 | 2002 | 2002 | 1.37 | 2742.74 | 16 | 6 | 80 | 2194.19 | 80 | 1097.10 | 3291.29 |
| 8 | 21 | 100 | 2603 | 2603 | 1.37 | 3566.11 | 16 | 6 | 80 | 2852.39 | 80 | 1426.44 | 4279.33 |
| 8 | 22 | 100 | 4552 | 4552 | 1.37 | 6236.24 | 17 | 5 | 70 | 4365.37 | 75 | 2338.59 | 6703.96 |
| 8 | 29 | 100 | 2467 | 2467 | 1.37 | 3379.79 | 16 | 6 | 80 | 2703.83 | 80 | 1351.92 | 4055.75 |
| 8 | 30 | 100 | 1025 | 1025 | 1.37 | 1404.25 | 16 | 6 | 80 | 1123.40 | 80 | 561.70 | 1685.10 |
| 8 | 31 | 100 | 1512 | 1512 | 1.37 | 2071.44 | 16 | 6 | 80 | 1657.15 | 80 | 828.58 | 2485.73 |
| 8 | 32 | 100 | 1785 | 1785 | 1.37 | 2445.45 | 16 | 6 | 80 | 1956.36 | 80 | 978.18 | 2934.54 |
| 8 | 33 | 100 | 679 | 679 | 1.37 | 930.23 | 16 | 6 | 80 | 744.18 | 80 | 372.09 | 1116.28 |
| 8 | 35 | 100 | 1763 | 1763 | 1.37 | 2415.31 | 16 | 6 | 80 | 1932.25 | 80 | 966.12 | 2898.37 |
| 8 | 36 | 100 | 1345 | 1345 | 1.37 | 1842.65 | 15 | 7 | 85 | 1566.25 | 90 | 829.19 | 2395.45 |
| 8 | 37 | 100 | 1403 | 1403 | 1.37 | 1922.11 | 15 | 7 | 85 | 1633.79 | 90 | 864.95 | 2498.74 |
| 8 | 38 | 100 | 717 | 717 | 1.37 | 982.29 | 14 | 8 | 90 | 884.06 | 100 | 491.15 | 1375.21 |
| 8 | 39 | 100 | 748 | 748 | 1.37 | 1024.76 | 16 | 6 | 80 | 819.81 | 80 | 409.90 | 1229.71 |
| 8 | 40 | 100 | 741 | 741 | 1.37 | 1015.17 | 14 | 8 | 90 | 913.65 | 100 | 507.59 | 1421.24 |
| 8 | 41 | 100 | 779 | 779 | 1.37 | 1067.23 | 14 | 8 | 90 | 960.51 | 100 | 533.62 | 1494.12 |
| 8 | 42 | 100 | 1035 | 1035 | 1.37 | 1417.95 | 14 | 8 | 90 | 1276.16 | 100 | 708.98 | 1985.13 |
| 8 | 43 | 100 | 601 | 601 | 1.37 | 823.37 | 16 | 6 | 80 | 658.70 | 80 | 329.35 | 988.04 |
| 8 | 44 | 100 | 993 | 993 | 1.37 | 1360.41 | 16 | 6 | 80 | 1088.33 | 80 | 544.16 | 1632.49 |
| 8 | 45 | 100 | 479 | 479 | 1.37 | 656.23 | 16 | 6 | 80 | 524.98 | 80 | 262.49 | 787.48 |
| 8 | 46 | 100 | 573 | 573 | 1.37 | 785.01 | 16 | 6 | 80 | 628.01 | 80 | 314.00 | 942.01 |
| 8 | 47 | 100 | 2641 | 2641 | 1.37 | 3618.17 | 16 | 6 | 80 | 2894.54 | 80 | 1447.27 | 4341.80 |
| 8 | 48 | 100 | 2119 | 2119 | 1.37 | 2903.03 | 16 | 6 | 80 | 2322.42 | 80 | 1161.21 | 3483.64 |
| 8 | 49 | 100 | 945 | 945 | 1.37 | 1294.65 | 14 | 8 | 90 | 1165.19 | 100 | 647.33 | 1812.51 |
| 10 | 10 | 100 | 270 | 270 | 1.37 | 369.90 | 16 | 6 | 80 | 295.92 | 80 | 147.96 | 443.88 |
| 10 | 19 | 100 | 537 | 537 | 1.37 | 735.69 | 16 | 6 | 80 | 588.55 | 80 | 294.28 | 882.83 |
| 10 | 32 | 100 | 1656 | 1656 | 1.37 | 2268.72 | 18 | 4 | 60 | 1361.23 | 70 | 794.05 | 2155.28 |
| 10 | 34 | 100 | 503 | 503 | 1.37 | 689.11 | 18 | 4 | 60 | 413.47 | 70 | 241.19 | 654.65 |
| 10 | 37 | 100 | 149 | 149 | 1.37 | 204.13 | 26 | 0 | 0 | 0 | 0 | 0 | 0 |
| 10 | 40 | 100 | 1395 | 1395 | 1.37 | 1911.15 | 16 | 6 | 80 | 1528.92 | 80 | 764.46 | 2293.38 |
| 10 | 41 | 100 | 731 | 731 | 1.37 | 1001.47 | 16 | 6 | 80 | 801.18 | 80 | 400.59 | 1201.76 |
| 10 | 42 | 100 | 858 | 858 | 1.37 | 1175.46 | 28 | 0 | 0 | 0 | 0 | 0 | 0 |
| 10 | 43 | 100 | 931 | 931 | 1.37 | 1275.47 | 18 | 4 | 60 | 765.28 | 70 | 446.41 | 1211.70 |
| 10 | 44 | 100 | 241 | 241 | 1.37 | 330.17 | 18 | 4 | 60 | 198.10 | 70 | 115.56 | 313.66 |
| 10 | 45 | 100 | 266 | 266 | 1.37 | 364.42 | 18 | 4 | 60 | 218.65 | 70 | 127.55 | 346.20 |
| 10 | 46 | 100 | 2355 | 2355 | 1.37 | 3226.35 | 18 | 4 | 60 | 1935.81 | 70 | 1129.22 | 3065.03 |
| 10 | 47 | 100 | 652 | 652 | 1.37 | 893.24 | 0 | 22 | 100 | 893.24 | 100 | 446.62 | 1339.86 |
| 10 | 48 | 100 | 1857 | 1857 | 1.37 | 2544.09 | 18 | 4 | 60 | 1526.45 | 70 | 890.43 | 2416.88 |

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| BOOK | PAGE | BK/PG% | BK/PGV | (%)(VAL) | %INCR | MKT VALUE | ELEV. | DEPTH | %DAM STRU | STRU DAM | %DAM CONF | CONT DAM | TOTAL |
|------|------|--------|--------|----------|-------|--------------|-------|-------|--------------|-------------|--------------|-------------|---------|
| 10 | 49 | 100 | 1037 | 1037 | 1.37 | 1420.69 | 20 | 2 | 26 | 369.38 | 35 | 248.62 | 618.00 |
| 10 | 50 | 100 | 1560 | 1560 | 1.37 | 2137.20 | 18 | 4 | 60 | 1282.32 | 70 | 748.02 | 2030.34 |
| 10 | 51 | 100 | 936 | 936 | 1.37 | 1282.32 | 18 | 4 | 60 | 769.39 | 70 | 448.81 | 1218.20 |
| 10 | 52 | 100 | 1270 | 1270 | 1.37 | 1739.90 | 18 | 4 | 60 | 1043.94 | 70 | 608.97 | 1652.91 |
| 10 | 53 | 100 | 0 | 0 | 1.37 | 0 | 18 | 4 | 60 | 0 | 70 | 0 | 0 |
| 14 | 3 | 100 | 866 | 866 | 1.37 | 1188.42 | 20 | 2 | 26 | 308.47 | 35 | 207.62 | 516.09 |
| 14 | 4 | 100 | 668 | 668 | 1.37 | 915.16 | 23 | 1 | 8 | 73.21 | 0 | 0 | 73.21 |
| 14 | 5 | 100 | 1167 | 1167 | 1.37 | 1598.79 | 17 | 5 | 70 | 1119.15 | 75 | 599.55 | 1719.70 |
| 14 | 6 | 100 | 1603 | 1603 | 1.37 | 2196.11 | 18 | 4 | 60 | 1317.67 | 70 | 768.64 | 2086.30 |
| 14 | 7 | 100 | 1558 | 1558 | 1.37 | 2134.46 | 20 | 2 | 26 | 554.96 | 35 | 373.53 | 928.49 |
| 14 | 8 | 100 | 727 | 727 | 1.37 | 995.99 | 22 | 0 | 0 | 0 | 0 | 0 | 0 |
| 14 | 9 | 100 | 614 | 614 | 1.37 | 841.18 | 16 | 6 | 80 | 672.94 | 80 | 336.47 | 1009.42 |
| 14 | 12 | 100 | 1833 | 1833 | 1.37 | 2511.21 | 20 | 2 | 26 | 652.91 | 35 | 439.46 | 1092.38 |
| 14 | 13 | 100 | 729 | 729 | 1.37 | 998.73 | 22 | 0 | 0 | 0 | 0 | 0 | 0 |
| 14 | 24 | 100 | 2270 | 2270 | 1.37 | 3109.90 | 18 | 4 | 60 | 1865.94 | 70 | 1088.47 | 2954.41 |
| 14 | 25 | 100 | 2770 | 2770 | 1.37 | 3794.90 | 16 | 6 | 80 | 3035.92 | 80 | 1517.96 | 4553.88 |
| 14 | 26 | 100 | 2534 | 2534 | 1.37 | 3471.52 | 18 | 4 | 60 | 2082.95 | 70 | 1215.05 | 3298.00 |
| 14 | 27 | 100 | 2137 | 2137 | 1.37 | 2927.69 | 16 | 6 | 80 | 2342.15 | 80 | 1171.08 | 3513.23 |
| 14 | 28 | 100 | 2123 | 2123 | 1.37 | 2908.51 | 16 | 6 | 80 | 2326.81 | 80 | 1163.40 | 3490.21 |
| 14 | 29 | 100 | 3262 | 3262 | 1.37 | 4468.94 | 16 | 6 | 80 | 3575.15 | 80 | 1787.58 | 5362.73 |
| 14 | 31 | 100 | 2297 | 2297 | 1.37 | 3146.89 | 16 | 6 | 80 | 2517.51 | 80 | 1258.76 | 3776.27 |
| 14 | 33 | 100 | 2198 | 2198 | 1.37 | 3011.26 | 16 | 6 | 80 | 2409.01 | 80 | 1204.50 | 3613.51 |
| 14 | 34 | 100 | 1025 | 1025 | 1.37 | 1404.25 | 16 | 6 | 80 | 1123.40 | 80 | 561.70 | 1685.10 |
| 14 | 35 | 100 | 2942 | 2942 | 1.37 | 4030.54 | 16 | 6 | 80 | 3224.43 | 80 | 1612.22 | 4836.65 |
| 14 | 36 | 100 | 1199 | 1199 | 1.37 | 1642.63 | 18 | 4 | 60 | 985.52 | 70 | 574.92 | 1560.50 |
| 14 | 37 | 100 | 5661 | 5661 | 1.37 | 7755.57 | 20 | 2 | 26 | 2016.45 | 35 | 1357.22 | 3373.67 |
| 14 | 38 | 100 | 2913 | 2913 | 1.37 | 3990.81 | 20 | 2 | 26 | 1037.61 | 35 | 698.39 | 1736.00 |
| 14 | 46 | 100 | 600 | 600 | 1.37 | 822 | 18 | 4 | 60 | 493.20 | 70 | 287.70 | 780.90 |
| 14 | 47 | 100 | 292 | 292 | 1.37 | 400.04 | 16 | 6 | 80 | 320.03 | 80 | 160.02 | 480.05 |
| 14 | 48 | 100 | 262 | 262 | 1.37 | 358.94 | 18 | 4 | 60 | 215.36 | 70 | 125.63 | 340.99 |
| 14 | 49 | 100 | 827 | 827 | 1.37 | 1132.99 | 18 | 4 | 60 | 679.79 | 70 | 396.55 | 1076.34 |
| 14 | 50 | 100 | 2304 | 2304 | 1.37 | 3156.48 | 18 | 4 | 60 | 1893.89 | 70 | 1104.77 | 2998.66 |
| 14 | 53 | 100 | 1774 | 1774 | 1.37 | 2430.38 | 16 | 6 | 80 | 1944.30 | 80 | 972.15 | 2916.46 |
| 14 | 54 | 100 | 3077 | 3077 | 1.37 | 4215.49 | 16 | 6 | 80 | 3372.39 | 80 | 1686.20 | 5058.59 |
| 14 | 55 | 100 | 1323 | 1323 | 1.37 | 1812.51 | 16 | 6 | 80 | 1450.01 | 80 | 725.00 | 2175.01 |
| 14 | 56 | 100 | 1891 | 1891 | 1.37 | 2590.67 | 16 | 6 | 80 | 2072.54 | 80 | 1036.27 | 3108.80 |
| 14 | 57 | 100 | 688 | 688 | 1.37 | 942.56 | 16 | 6 | 80 | 754.05 | 80 | 377.02 | 1131.07 |
| 14 | 58 | 100 | 0 | 0 | 1.37 | 0 | 22 | 0 | 0 | 0 | 0 | 0 | 0 |
| 14 | 59 | 100 | 257 | 257 | 1.37 | 352.09 | 18 | 4 | 60 | 211.25 | 70 | 123.23 | 334.49 |
| 14 | 60 | 100 | 33 | 33 | 1.37 | 45.21 | 16 | 6 | 80 | 36.17 | 80 | 18.08 | 54.25 |
| 14 | 61 | 100 | 33 | 33 | 1.37 | 45.21 | 26 | 0 | 0 | 0 | 0 | 0 | 0 |
| 14 | 62 | 100 | 17 | 17 | 1.37 | 23.29 | 27 | 0 | 0 | 0 | 0 | 0 | 0 |
| 14 | 63 | 100 | 510 | 510 | 1.37 | 698.70 | 20 | 2 | 26 | 181.66 | 35 | 122.27 | 303.93 |
| 14 | 64 | 100 | 1922 | 1922 | 1.37 | 2633.14 | 18 | 4 | 60 | 1579.88 | 70 | 921.60 | 2501.48 |
| 58 | 1 | 100 | 3148 | 3148 | 1.37 | 4312.76 | 20 | 2 | 26 | 1121.32 | 35 | 754.73 | 1876.05 |
| 58 | 2 | 100 | 634 | 634 | 1.37 | 868.58 | 20 | 2 | 26 | 225.83 | 35 | 152.00 | 377.83 |
| 58 | 3 | 100 | 2297 | 2297 | 1.37 | 3146.89 | 23 | 0 | 0 | 0 | 0 | 0 | 0 |
| 58 | 4 | 100 | 2045 | 2045 | 1.37 | 2801.65 | 18 | 4 | 60 | 1680.99 | 70 | 980.58 | 2661.57 |
| 58 | 5 | 100 | 2093 | 2093 | 1.37 | 2867.41 | 20 | 2 | 26 | 745.53 | 35 | 501.80 | 1247.32 |

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| BOOK | PAGE | BK/PG% | BK/PGV | (%)(VAL) | %INCR | MKT VALUE | ELEV. | DEPTH | %DAM STRU | STRU DAM | %DAM CONT | CONT DAM | TOTAL |
|------|------|--------|--------|----------|-------|--------------|-------|-------|--------------|-------------|--------------|-------------|----------|
| 58 | 6 | 100 | 324 | 324 | 1.37 | 443.88 | 20 | 2 | 26 | 115.41 | 35 | 77.68 | 193.09 |
| 58 | 7 | 100 | 1624 | 1624 | 1.37 | 2224.88 | 20 | 2 | 26 | 578.47 | 35 | 389.35 | 967.82 |
| 58 | 8 | 100 | 1291 | 1291 | 1.37 | 1768.67 | 20 | 2 | 26 | 459.85 | 35 | 309.52 | 769.37 |
| 58 | 9 | 100 | 2460 | 2460 | 1.37 | 3370.20 | 18 | 4 | 60 | 2022.12 | 70 | 1179.57 | 3201.69 |
| 58 | 10 | 100 | 1473 | 1473 | 1.37 | 2018.01 | 19 | 3 | 45 | 908.10 | 60 | 605.40 | 1513.51 |
| 58 | 11 | 100 | 1650 | 1650 | 1.37 | 2260.50 | 18 | 4 | 60 | 1356.30 | 70 | 791.18 | 2147.48 |
| 58 | 12 | 100 | 4018 | 4018 | 1.37 | 5504.66 | 18 | 4 | 60 | 3302.80 | 70 | 1926.63 | 5229.43 |
| 58 | 13 | 100 | 2956 | 2956 | 1.37 | 4049.72 | 16 | 6 | 80 | 3239.78 | 80 | 1619.89 | 4859.66 |
| 58 | 14 | 100 | 1133 | 1133 | 1.37 | 1552.21 | 14 | 8 | 90 | 1396.99 | 100 | 776.11 | 2173.09 |
| 58 | 15 | 100 | 1428 | 1428 | 1.37 | 1956.36 | 18 | 4 | 60 | 1173.82 | 70 | 684.73 | 1858.54 |
| 58 | 16 | 100 | 1671 | 1671 | 1.37 | 2289.27 | 18 | 4 | 60 | 1373.56 | 70 | 801.24 | 2174.81 |
| 58 | 17 | 100 | 997 | 997 | 1.37 | 1365.89 | 18 | 4 | 60 | 819.53 | 70 | 478.06 | 1297.60 |
| 58 | 18 | 100 | 4147 | 4147 | 1.37 | 5681.39 | 16 | 6 | 80 | 4545.11 | 80 | 2272.56 | 6817.67 |
| 58 | 19 | 100 | 3065 | 3065 | 1.37 | 4199.05 | 18 | 4 | 60 | 2519.43 | 70 | 1469.67 | 3989.10 |
| 58 | 20 | 100 | 1727 | 1727 | 1.37 | 2365.99 | 18 | 4 | 60 | 1419.59 | 70 | 828.10 | 2247.69 |
| 58 | 21 | 100 | 1990 | 1990 | 1.37 | 2726.30 | 20 | 2 | 26 | 708.84 | 35 | 477.10 | 1185.94 |
| 58 | 22 | 100 | 1613 | 1613 | 1.37 | 2209.81 | 18 | 4 | 60 | 1325.89 | 70 | 773.43 | 2099.32 |
| 58 | 23 | 100 | 2502 | 2502 | 1.37 | 3427.74 | 16 | 6 | 80 | 2742.19 | 80 | 1371.10 | 4113.29 |
| 58 | 24 | 100 | 3260 | 3260 | 1.37 | 4466.20 | 16 | 6 | 80 | 3572.96 | 80 | 1786.48 | 5359.44 |
| 58 | 25 | 100 | 950 | 950 | 1.37 | 1301.50 | 14 | 8 | 90 | 1171.35 | 100 | 650.75 | 1822.10 |
| 58 | 26 | 100 | 2684 | 2684 | 1.37 | 3677.08 | 28 | 0 | 0 | 0 | 0 | 0 | 0 |
| 58 | 27 | 100 | 2023 | 2023 | 1.37 | 2771.51 | 28 | 0 | 0 | 0 | 0 | 0 | 0 |
| 58 | 28 | 100 | 1832 | 1832 | 1.37 | 2509.84 | 28 | 0 | 0 | 0 | 0 | 0 | 0 |
| 58 | 29 | 100 | 423 | 423 | 1.37 | 579.51 | 22 | 0 | 0 | 0 | 0 | 0 | 0 |
| 58 | 30 | 100 | 355 | 355 | 1.37 | 482.35 | 20 | 2 | 26 | 126.45 | 35 | 85.11 | 211.56 |
| 58 | 31 | 100 | 1337 | 1337 | 1.37 | 1831.69 | 22 | 0 | 0 | 0 | 0 | 0 | 0 |
| 58 | 32 | 100 | 5715 | 5715 | 1.37 | 7829.55 | 28 | 0 | 0 | 0 | 0 | 0 | 0 |
| 58 | 33 | 100 | 4205 | 4205 | 1.37 | 576.85 | 28 | 0 | 0 | 0 | 0 | 0 | 0 |
| 58 | 34 | 100 | 1663 | 1663 | 1.37 | 2275.31 | 28 | 0 | 0 | 0 | 0 | 0 | 0 |
| 58 | 35 | 100 | 10017 | 10017 | 1.37 | 13723.29 | 26 | 0 | 0 | 0 | 0 | 0 | 0 |
| 67 | 1 | 100 | 1246 | 1246 | 1.37 | 1707.02 | 10 | 12 | 100 | 1707.02 | 100 | 853.51 | 2560.53 |
| 67 | 2 | 100 | 19191 | 19191 | 1.37 | 26291.67 | 10 | 12 | 100 | 26291.67 | 100 | 13145.84 | 39437.51 |
| 67 | 3 | 100 | 9744 | 9744 | 1.37 | 13349.28 | 10 | 12 | 100 | 13349.28 | 100 | 6674.64 | 20023.92 |
| 67 | 4 | 100 | 48497 | 48497 | 1.37 | 66440.89 | 10 | 12 | 100 | 66440.89 | 100 | 33220.45 | 99661.34 |
| 67 | 5 | 100 | 46739 | 46739 | 1.37 | 64032.43 | 10 | 12 | 100 | 64032.43 | 100 | 32016.22 | 96048.65 |
| 67 | 6 | 100 | 2458 | 2458 | 1.37 | 3367.46 | 10 | 12 | 100 | 3367.46 | 100 | 1683.73 | 5051.19 |
| 67 | 7 | 100 | 2550 | 2550 | 1.37 | 3493.50 | 10 | 12 | 100 | 3493.50 | 100 | 1746.75 | 5240.25 |
| 67 | 8 | 100 | 1563 | 1563 | 1.37 | 2141.31 | 10 | 12 | 100 | 2141.31 | 100 | 1070.66 | 3211.97 |
| 67 | 9 | 100 | 1460 | 1460 | 1.37 | 2000.20 | 10 | 12 | 100 | 2000.20 | 100 | 1000.10 | 3000.30 |
| 67 | 10 | 100 | 4055 | 4055 | 1.37 | 5555.35 | 11 | 11 | 100 | 5555.35 | 100 | 2777.68 | 8333.03 |
| 67 | 11 | 100 | 0 | 0 | 1.37 | 0 | 10 | 12 | 100 | 0 | 100 | 0 | 0 |
| 67 | 12 | 100 | 1737 | 1737 | 1.37 | 2379.69 | 14 | 8 | 90 | 2141.72 | 100 | 1189.85 | 3331.57 |
| 67 | 13 | 100 | 15539 | 15539 | 1.37 | 21288.43 | 10 | 12 | 100 | 21288.43 | 100 | 10644.22 | 31932.65 |
| 67 | 14 | 100 | 13898 | 13898 | 1.37 | 19040.26 | 12 | 10 | 100 | 19040.26 | 100 | 9520.13 | 28560.39 |
| 67 | 15 | 100 | 22527 | 22527 | 1.37 | 30861.99 | 12 | 10 | 100 | 30861.99 | 100 | 15431.00 | 46292.99 |
| 67 | 16 | 100 | 19078 | 19078 | 1.37 | 26136.86 | 14 | 8 | 90 | 23523.17 | 100 | 13068.43 | 36591.60 |
| 67 | 17 | 100 | 6722 | 6722 | 1.37 | 9209.14 | 14 | 8 | 90 | 8288.23 | 100 | 4604.57 | 12892.80 |
| 67 | 18 | 100 | 92 | 92 | 1.37 | 126.04 | 13 | 9 | 100 | 126.04 | 100 | 63.02 | 189.06 |
| 67 | 19 | 100 | 1671 | 1671 | 1.37 | 2289.27 | 14 | 8 | 90 | 2060.34 | 100 | 1144.64 | 3204.98 |

AMERICAN RIVER
AREA 6 - WEST SACRAMENTO
1985 / 1986
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| BOOK | PAGE | BK/PG% | BK/PGV | (%)(VAL) | %INCR | MKT VALUE | ELEV. | DEPTH | %DAM STRU | STRU DAM | %DAM CONT | CONT DAM | TOTAL |
|-------|------|--------|--------|----------|-------|--------------|-------|-------|--------------|-------------|--------------|-------------|---------|
| 67 | 20 | 100 | 4335 | 4335 | 1.37 | 5938.95 | 14 | 8 | 90 | 5345.06 | 100 | 2969.48 | 8314.53 |
| 67 | 21 | 100 | 1260 | 1260 | 1.37 | 1726.20 | 12 | 10 | 100 | 1726.20 | 100 | 863.10 | 2589.30 |
| 67 | 22 | 100 | 1143 | 1143 | 1.37 | 1565.91 | 14 | 8 | 90 | 1409.32 | 100 | 782.96 | 2192.27 |
| 67 | 23 | 100 | 3473 | 3473 | 1.37 | 4758.01 | 16 | 6 | 80 | 3806.41 | 80 | 1903.20 | 5709.61 |
| 67 | 24 | 100 | 1324 | 1324 | 1.37 | 1813.88 | 16 | 6 | 80 | 1451.10 | 80 | 725.55 | 2176.66 |
| 67 | 25 | 100 | 1472 | 1472 | 1.37 | 2016.64 | 16 | 6 | 80 | 1613.31 | 80 | 806.66 | 2419.97 |
| 67 | 26 | 100 | 2133 | 2133 | 1.37 | 2922.21 | 16 | 6 | 80 | 2337.77 | 80 | 1168.99 | 3506.65 |
| 67 | 27 | 100 | 2818 | 2818 | 1.37 | 3860.66 | 16 | 6 | 80 | 3088.53 | 80 | 1544.26 | 4632.79 |
| 67 | 28 | 100 | 835 | 835 | 1.37 | 1143.95 | 16 | 6 | 80 | 915.16 | 80 | 457.58 | 1372.74 |
| 67 | 29 | 100 | 3520 | 3520 | 1.37 | 4822.40 | 16 | 6 | 80 | 3857.92 | 80 | 1928.96 | 5786.88 |
| 67 | 30 | 100 | 3830 | 3830 | 1.37 | 5247.10 | 18 | 4 | 60 | 3148.26 | 70 | 1836.49 | 4984.75 |
| 67 | 31 | 100 | 2829 | 2829 | 1.37 | 3875.73 | 16 | 6 | 80 | 3100.58 | 80 | 1550.29 | 4650.88 |
| 67 | 32 | 100 | 3441 | 3441 | 1.37 | 4714.17 | 16 | 6 | 80 | 3771.34 | 80 | 1885.67 | 5657.00 |
| 67 | 33 | 100 | 1808 | 1808 | 1.37 | 2476.96 | 14 | 8 | 90 | 2229.26 | 100 | 1238.48 | 3467.74 |
| TOTAL | | | 468947 | | | 6.42E+5 | | | | 5.01E+5 | | 2.59E+5 | 7.61E+5 |

AMERICAN RIVER
AREA 6 - WEST SACRAMENTO
1985 / 1986
FLOOD ELEVATION 22'

| BOOK | PAGE | BK/P6% | BK/P6V | (%)(VAL) | %INCR | MKT VALUE | ELEV. | DEPTH | %DAM STRU | STRU DAM | %DAM CONT | CONT DAM | TOTAL |
|-------|------|--------|--------|----------|-------|--------------|-------|-------|--------------|-------------|--------------|-------------|---------|
| 67 | 20 | 100 | 4335 | 4335 | 1.37 | 5938.95 | 14 | 8 | 90 | 5345.06 | 100 | 2969.48 | 8314.53 |
| 67 | 21 | 100 | 1260 | 1260 | 1.37 | 1726.20 | 12 | 10 | 100 | 1726.20 | 100 | 863.10 | 2589.30 |
| 67 | 22 | 100 | 1143 | 1143 | 1.37 | 1565.91 | 14 | 8 | 90 | 1409.32 | 100 | 782.96 | 2192.27 |
| 67 | 23 | 100 | 3473 | 3473 | 1.37 | 4758.01 | 16 | 6 | 80 | 3806.41 | 80 | 1903.20 | 5709.61 |
| 67 | 24 | 100 | 1324 | 1324 | 1.37 | 1813.88 | 16 | 6 | 80 | 1451.10 | 80 | 725.55 | 2176.66 |
| 67 | 25 | 100 | 1472 | 1472 | 1.37 | 2016.64 | 16 | 6 | 80 | 1613.31 | 80 | 806.66 | 2419.97 |
| 67 | 26 | 100 | 2133 | 2133 | 1.37 | 2922.21 | 16 | 6 | 80 | 2337.77 | 80 | 1168.98 | 3506.65 |
| 67 | 27 | 100 | 2818 | 2818 | 1.37 | 3860.66 | 16 | 6 | 80 | 3088.53 | 80 | 1544.26 | 4632.79 |
| 67 | 28 | 100 | 835 | 835 | 1.37 | 1143.95 | 16 | 6 | 80 | 915.16 | 80 | 457.58 | 1372.74 |
| 67 | 29 | 100 | 3520 | 3520 | 1.37 | 4822.40 | 16 | 6 | 80 | 3857.92 | 80 | 1928.96 | 5786.88 |
| 67 | 30 | 100 | 3830 | 3830 | 1.37 | 5247.10 | 18 | 4 | 60 | 3148.26 | 70 | 1836.49 | 4984.75 |
| 67 | 31 | 100 | 2829 | 2829 | 1.37 | 3875.73 | 16 | 6 | 80 | 3100.58 | 80 | 1550.29 | 4650.88 |
| 67 | 32 | 100 | 3441 | 3441 | 1.37 | 4714.17 | 16 | 6 | 80 | 3771.34 | 80 | 1885.67 | 5657.00 |
| 67 | 33 | 100 | 1808 | 1808 | 1.37 | 2476.96 | 14 | 8 | 90 | 2229.26 | 100 | 1238.48 | 3467.74 |
| TOTAL | | | 468947 | | | 6.42E+5 | | | | 5.01E+5 | | 2.59E+5 | 7.61E+5 |

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1987 / 1988
FLOOD ELEVATION 19'

| BOOK | PAGE | BK/PG% | BK/PGV | (%)(VAL) | %INCR | MKT VALUE | ELEV. | DEPTH | %DAM STRU | STRU DAM | %DAM CONT | CONT DAM | TOTAL |
|------|------|--------|--------|----------|-------|--------------|-------|-------|--------------|-------------|--------------|-------------|----------|
| 45 | 4 | 100 | 2185 | 2185 | 1.37 | 2993.45 | 15 | 4 | 60 | 1796.07 | 70 | 1047.71 | 2843.78 |
| 45 | 5 | 100 | 2044 | 2044 | 1.37 | 2800.28 | 15 | 4 | 60 | 1680.17 | 70 | 980.10 | 2660.27 |
| 45 | 11 | 100 | 586 | 586 | 1.37 | 802.82 | 10 | 9 | 100 | 802.82 | 100 | 401.41 | 1204.23 |
| 45 | 12 | 100 | 4220 | 4220 | 1.37 | 5781.40 | 10 | 9 | 100 | 5781.40 | 100 | 2890.70 | 8672.10 |
| 45 | 16 | 100 | 856 | 856 | 1.37 | 1172.72 | 10 | 9 | 100 | 1172.72 | 100 | 586.36 | 1759.08 |
| 45 | 17 | 100 | 472 | 472 | 1.37 | 646.64 | 10 | 9 | 100 | 646.64 | 100 | 323.32 | 969.96 |
| 45 | 18 | 100 | 823 | 823 | 1.37 | 1127.51 | 10 | 9 | 100 | 1127.51 | 100 | 563.76 | 1691.27 |
| 45 | 19 | 100 | 101 | 101 | 1.37 | 138.37 | 10 | 9 | 100 | 138.37 | 100 | 69.19 | 207.56 |
| 45 | 20 | 100 | 4 | 4 | 1.37 | 5.48 | 10 | 9 | 100 | 5.48 | 100 | 2.74 | 8.22 |
| 45 | 21 | 100 | 642 | 642 | 1.37 | 879.54 | 10 | 9 | 100 | 879.54 | 100 | 439.77 | 1319.31 |
| 45 | 22 | 100 | 52 | 52 | 1.37 | 71.24 | 10 | 9 | 100 | 71.24 | 100 | 35.62 | 106.86 |
| 45 | 23 | 100 | 79 | 79 | 1.37 | 108.23 | 10 | 9 | 100 | 108.23 | 100 | 54.12 | 162.35 |
| 45 | 24 | 100 | 137 | 137 | 1.37 | 187.69 | 10 | 9 | 100 | 187.69 | 100 | 93.85 | 281.54 |
| 45 | 26 | 100 | 233 | 233 | 1.37 | 319.21 | 10 | 9 | 100 | 319.21 | 100 | 159.61 | 478.82 |
| 45 | 27 | 100 | 363 | 363 | 1.37 | 497.31 | 10 | 9 | 100 | 497.31 | 100 | 248.66 | 745.97 |
| 45 | 28 | 100 | 1957 | 1957 | 1.37 | 2681.09 | 10 | 9 | 100 | 2681.09 | 100 | 1340.55 | 4021.64 |
| 45 | 29 | 100 | 958 | 958 | 1.37 | 1312.46 | 10 | 9 | 100 | 1312.46 | 100 | 656.23 | 1968.69 |
| 45 | 30 | 100 | 1220 | 1220 | 1.37 | 1671.40 | 10 | 9 | 100 | 1671.40 | 100 | 835.70 | 2507.10 |
| 45 | 31 | 100 | 463 | 463 | 1.37 | 634.31 | 10 | 9 | 100 | 634.31 | 100 | 317.16 | 951.47 |
| 45 | 32 | 100 | 988 | 988 | 1.37 | 1353.56 | 10 | 9 | 100 | 1353.56 | 100 | 676.78 | 2030.34 |
| 45 | 33 | 100 | 919 | 919 | 1.37 | 1259.03 | 10 | 9 | 100 | 1259.03 | 100 | 629.52 | 1888.55 |
| 45 | 34 | 100 | 743 | 743 | 1.37 | 1017.91 | 10 | 9 | 100 | 1017.91 | 100 | 508.96 | 1526.87 |
| 45 | 35 | 100 | 401 | 401 | 1.37 | 549.37 | 10 | 9 | 100 | 549.37 | 100 | 274.69 | 824.06 |
| 45 | 37 | 100 | 3224 | 3224 | 1.37 | 4416.88 | 10 | 9 | 100 | 4416.88 | 100 | 2208.44 | 6625.32 |
| 45 | 38 | 100 | 4719 | 4719 | 1.37 | 6465.03 | 10 | 9 | 100 | 6465.03 | 100 | 3232.52 | 9697.55 |
| 45 | 39 | 100 | 2914 | 2914 | 1.37 | 3992.18 | 10 | 9 | 100 | 3992.18 | 100 | 1996.09 | 5988.27 |
| 45 | 40 | 100 | 3630 | 3630 | 1.37 | 4973.10 | 10 | 9 | 100 | 4973.10 | 100 | 2486.55 | 7459.65 |
| 45 | 41 | 100 | 4071 | 4071 | 1.37 | 5577.27 | 10 | 9 | 100 | 5577.27 | 100 | 2788.64 | 8365.91 |
| 45 | 42 | 100 | 3912 | 3912 | 1.37 | 5359.44 | 10 | 9 | 100 | 5359.44 | 100 | 2679.72 | 8039.16 |
| 45 | 43 | 100 | 2436 | 2436 | 1.37 | 3337.32 | 10 | 9 | 100 | 3337.32 | 100 | 1668.66 | 5005.98 |
| 45 | 44 | 100 | 4220 | 4220 | 1.37 | 5781.40 | 10 | 9 | 100 | 5781.40 | 100 | 2890.70 | 8672.10 |
| 45 | 45 | 100 | 5915 | 5915 | 1.37 | 8103.55 | 10 | 9 | 100 | 8103.55 | 100 | 4051.78 | 12155.33 |
| 45 | 46 | 100 | 4234 | 4234 | 1.37 | 5800.58 | 10 | 9 | 100 | 5800.58 | 100 | 2900.29 | 8700.87 |
| 45 | 50 | 100 | 2689 | 2689 | 1.37 | 3683.93 | 10 | 9 | 100 | 3683.93 | 100 | 1841.97 | 5525.90 |
| 46 | 1 | 100 | 308 | 308 | 1.37 | 421.96 | 15 | 4 | 60 | 253.18 | 70 | 147.69 | 400.86 |
| 46 | 2 | 100 | 986 | 986 | 1.37 | 1350.82 | 10 | 9 | 100 | 1350.82 | 100 | 675.41 | 2026.23 |
| 46 | 3 | 100 | 277 | 277 | 1.37 | 379.49 | 15 | 4 | 60 | 227.69 | 70 | 132.82 | 360.51 |
| 46 | 4 | 100 | 353 | 353 | 1.37 | 483.61 | 15 | 4 | 60 | 290.17 | 70 | 169.26 | 459.43 |
| 46 | 5 | 100 | 607 | 607 | 1.37 | 831.59 | 13 | 6 | 80 | 665.27 | 80 | 332.64 | 997.91 |
| 46 | 6 | 100 | 1270 | 1270 | 1.37 | 1739.90 | 15 | 4 | 60 | 1043.94 | 70 | 608.97 | 1652.91 |
| 46 | 7 | 100 | 979 | 979 | 1.37 | 1341.23 | 15 | 4 | 60 | 804.74 | 70 | 469.43 | 1274.17 |
| 46 | 8 | 100 | 859 | 859 | 1.37 | 1176.83 | 15 | 4 | 60 | 706.10 | 70 | 411.89 | 1117.99 |
| 46 | 9 | 100 | 850 | 850 | 1.37 | 1164.50 | 15 | 4 | 60 | 698.70 | 70 | 407.58 | 1106.28 |
| 46 | 10 | 100 | 73 | 73 | 1.37 | 100.01 | 13 | 6 | 80 | 80.01 | 80 | 40.00 | 120.01 |
| 46 | 11 | 100 | 281 | 281 | 1.37 | 384.97 | 10 | 9 | 100 | 384.97 | 100 | 192.49 | 577.46 |
| 46 | 12 | 100 | 422 | 422 | 1.37 | 578.14 | 10 | 9 | 100 | 578.14 | 100 | 289.07 | 867.21 |
| 46 | 13 | 100 | 676 | 676 | 1.37 | 926.12 | 10 | 9 | 100 | 926.12 | 100 | 463.06 | 1389.18 |
| 46 | 14 | 100 | 3154 | 3154 | 1.37 | 4320.98 | 10 | 9 | 100 | 4320.98 | 100 | 2160.49 | 6481.47 |

AMERICAN RIVER
AREA 6 - WEST SACRAMENTO
1987 / 1988
FLOOD ELEVATION 19'

| BOOK | PAGE | BK/PG% | BK/PGV | (%)(VAL) | %INCR | MYT VALUE | ELEV. | DEPTH | %DAM STRU | STRU DAM | %DAM CONT | CONT DAM | TOTAL |
|-------|------|--------|--------|----------|-------|--------------|-------|-------|--------------|-------------|--------------|-------------|---------|
| 46 | 15 | 100 | 614 | 614 | 1.37 | 841.18 | 10 | 9 | 100 | 841.18 | 100 | 420.59 | 1261.77 |
| 46 | 16 | 100 | 948 | 948 | 1.37 | 1298.76 | 10 | 9 | 100 | 1298.76 | 100 | 649.38 | 1948.14 |
| 46 | 17 | 100 | 110 | 110 | 1.37 | 150.70 | 10 | 9 | 100 | 150.70 | 100 | 75.35 | 226.05 |
| 46 | 18 | 100 | 147 | 147 | 1.37 | 201.39 | 10 | 9 | 100 | 201.39 | 100 | 100.70 | 302.09 |
| 46 | 19 | 100 | 149 | 149 | 1.37 | 204.13 | 10 | 9 | 100 | 204.13 | 100 | 102.07 | 306.20 |
| 46 | 21 | 100 | 252 | 252 | 1.37 | 345.24 | 15 | 4 | 60 | 207.14 | 70 | 120.83 | 327.98 |
| 46 | 22 | 100 | 276 | 276 | 1.37 | 378.12 | 15 | 4 | 60 | 226.87 | 70 | 132.34 | 359.21 |
| 46 | 23 | 100 | 1115 | 1115 | 1.37 | 1527.55 | 15 | 4 | 60 | 916.53 | 70 | 534.64 | 1451.17 |
| 46 | 24 | 100 | 1003 | 1003 | 1.37 | 1374.11 | 10 | 9 | 100 | 1374.11 | 100 | 687.06 | 2061.17 |
| 46 | 25 | 100 | 469 | 469 | 1.37 | 642.53 | 15 | 4 | 60 | 385.52 | 70 | 224.89 | 610.40 |
| 46 | 26 | 100 | 245 | 245 | 1.37 | 335.65 | 15 | 4 | 60 | 201.39 | 70 | 117.48 | 318.87 |
| 46 | 27 | 100 | 1079 | 1079 | 1.37 | 1478.23 | 10 | 9 | 100 | 1478.23 | 100 | 739.12 | 2217.35 |
| 46 | 28 | 100 | 395 | 395 | 1.37 | 541.15 | 10 | 9 | 100 | 541.15 | 100 | 270.58 | 811.73 |
| 46 | 29 | 100 | 3226 | 3226 | 1.37 | 4419.62 | 15 | 4 | 60 | 2651.77 | 70 | 1546.87 | 4198.64 |
| 46 | 30 | 100 | 1732 | 1732 | 1.37 | 2372.84 | 15 | 4 | 60 | 1423.70 | 70 | 830.49 | 2254.20 |
| TOTAL | | | 85265 | | | 1.17E+5 | | | | 1.08E+5 | | 54934.95 | 1.63E+5 |

AMERICAN RIVER
AREA 6 - WEST SACRAMENTO
1987 / 1988
FLOOD ELEVATION 19'

| BOOK | PAGE | BK/PG% | BK/PGV | (%)(VAL) | %INCR | MKT VALUE | ELEV. | DEPTH | %DAM STRU | STRU DAM | %DAM CONT | CONT DAM | TOTAL |
|------|------|--------|--------|----------|-------|--------------|-------|-------|--------------|-------------|--------------|-------------|----------|
| 45 | 4 | 100 | 2185 | 2185 | 1.37 | 2993.45 | 15 | 7 | 85 | 2544.43 | 90 | 1347.05 | 3891.49 |
| 45 | 5 | 100 | 2044 | 2044 | 1.37 | 2800.28 | 15 | 7 | 85 | 2380.24 | 90 | 1260.13 | 3640.36 |
| 45 | 11 | 100 | 586 | 586 | 1.37 | 802.82 | 10 | 12 | 100 | 802.82 | 100 | 401.41 | 1204.23 |
| 45 | 12 | 100 | 4220 | 4220 | 1.37 | 5781.40 | 10 | 12 | 100 | 5781.40 | 100 | 2890.70 | 8672.10 |
| 45 | 16 | 100 | 856 | 856 | 1.37 | 1172.72 | 10 | 12 | 100 | 1172.72 | 100 | 586.36 | 1759.08 |
| 45 | 17 | 100 | 472 | 472 | 1.37 | 646.64 | 10 | 12 | 100 | 646.64 | 100 | 323.32 | 969.96 |
| 45 | 18 | 100 | 823 | 823 | 1.37 | 1127.51 | 10 | 12 | 100 | 1127.51 | 100 | 563.76 | 1691.27 |
| 45 | 19 | 100 | 101 | 101 | 1.37 | 138.37 | 10 | 12 | 100 | 138.37 | 100 | 69.19 | 207.56 |
| 45 | 20 | 100 | 4 | 4 | 1.37 | 5.48 | 10 | 12 | 100 | 5.48 | 100 | 2.74 | 8.22 |
| 45 | 21 | 100 | 642 | 642 | 1.37 | 879.54 | 10 | 12 | 100 | 879.54 | 100 | 439.77 | 1319.31 |
| 45 | 22 | 100 | 52 | 52 | 1.37 | 71.24 | 10 | 12 | 100 | 71.24 | 100 | 35.62 | 106.86 |
| 45 | 23 | 100 | 79 | 79 | 1.37 | 108.23 | 10 | 12 | 100 | 108.23 | 100 | 54.12 | 162.35 |
| 45 | 24 | 100 | 137 | 137 | 1.37 | 187.69 | 10 | 12 | 100 | 187.69 | 100 | 93.85 | 281.54 |
| 45 | 26 | 100 | 233 | 233 | 1.37 | 319.21 | 10 | 12 | 100 | 319.21 | 100 | 159.61 | 478.82 |
| 45 | 27 | 100 | 363 | 363 | 1.37 | 497.31 | 10 | 12 | 100 | 497.31 | 100 | 248.66 | 745.97 |
| 45 | 28 | 100 | 1957 | 1957 | 1.37 | 2681.09 | 10 | 12 | 100 | 2681.09 | 100 | 1340.55 | 4021.64 |
| 45 | 29 | 100 | 956 | 956 | 1.37 | 1312.46 | 10 | 12 | 100 | 1312.46 | 100 | 656.23 | 1968.69 |
| 45 | 30 | 100 | 1220 | 1220 | 1.37 | 1671.40 | 10 | 12 | 100 | 1671.40 | 100 | 835.70 | 2507.10 |
| 45 | 31 | 100 | 463 | 463 | 1.37 | 634.31 | 10 | 12 | 100 | 634.31 | 100 | 317.16 | 951.47 |
| 45 | 32 | 100 | 988 | 988 | 1.37 | 1353.56 | 10 | 12 | 100 | 1353.56 | 100 | 676.78 | 2030.34 |
| 45 | 33 | 100 | 919 | 919 | 1.37 | 1259.03 | 10 | 12 | 100 | 1259.03 | 100 | 629.52 | 1888.55 |
| 45 | 34 | 100 | 743 | 743 | 1.37 | 1017.91 | 10 | 12 | 100 | 1017.91 | 100 | 508.96 | 1526.87 |
| 45 | 35 | 100 | 401 | 401 | 1.37 | 549.37 | 10 | 12 | 100 | 549.37 | 100 | 274.69 | 824.06 |
| 45 | 37 | 100 | 3224 | 3224 | 1.37 | 4416.88 | 10 | 12 | 100 | 4416.88 | 100 | 2208.44 | 6625.32 |
| 45 | 38 | 100 | 4719 | 4719 | 1.37 | 6465.03 | 10 | 12 | 100 | 6465.03 | 100 | 3232.52 | 9697.55 |
| 45 | 39 | 100 | 2914 | 2914 | 1.37 | 3992.18 | 10 | 12 | 100 | 3992.18 | 100 | 1996.09 | 5988.27 |
| 45 | 40 | 100 | 3630 | 3630 | 1.37 | 4973.10 | 10 | 12 | 100 | 4973.10 | 100 | 2486.55 | 7459.65 |
| 45 | 41 | 100 | 4071 | 4071 | 1.37 | 5577.27 | 10 | 12 | 100 | 5577.27 | 100 | 2788.64 | 8365.91 |
| 45 | 42 | 100 | 3912 | 3912 | 1.37 | 5359.44 | 10 | 12 | 100 | 5359.44 | 100 | 2679.72 | 8039.16 |
| 45 | 43 | 100 | 2436 | 2436 | 1.37 | 3337.32 | 10 | 12 | 100 | 3337.32 | 100 | 1668.66 | 5005.98 |
| 45 | 44 | 100 | 4220 | 4220 | 1.37 | 5781.40 | 10 | 12 | 100 | 5781.40 | 100 | 2890.70 | 8672.10 |
| 45 | 45 | 100 | 5915 | 5915 | 1.37 | 8103.55 | 10 | 12 | 100 | 8103.55 | 100 | 4051.78 | 12155.33 |
| 45 | 46 | 100 | 4234 | 4234 | 1.37 | 5800.58 | 10 | 12 | 100 | 5800.58 | 100 | 2900.29 | 8700.87 |
| 45 | 50 | 100 | 2689 | 2689 | 1.37 | 3683.93 | 10 | 12 | 100 | 3683.93 | 100 | 1841.97 | 5525.90 |
| 46 | 1 | 100 | 308 | 308 | 1.37 | 421.96 | 15 | 7 | 85 | 358.67 | 90 | 189.88 | 548.55 |
| 46 | 2 | 100 | 986 | 986 | 1.37 | 1350.82 | 10 | 12 | 100 | 1350.82 | 100 | 675.41 | 2026.23 |
| 46 | 3 | 100 | 277 | 277 | 1.37 | 379.49 | 15 | 7 | 85 | 322.57 | 90 | 170.77 | 493.34 |
| 46 | 4 | 100 | 353 | 353 | 1.37 | 483.61 | 15 | 7 | 85 | 411.07 | 90 | 217.62 | 628.69 |
| 46 | 5 | 100 | 607 | 607 | 1.37 | 831.59 | 13 | 9 | 100 | 831.59 | 100 | 415.80 | 1247.39 |
| 46 | 6 | 100 | 1270 | 1270 | 1.37 | 1739.90 | 15 | 7 | 85 | 1478.92 | 90 | 782.96 | 2261.87 |
| 46 | 7 | 100 | 979 | 979 | 1.37 | 1341.23 | 15 | 7 | 85 | 1140.05 | 90 | 603.55 | 1743.60 |
| 46 | 8 | 100 | 859 | 859 | 1.37 | 1176.83 | 15 | 7 | 85 | 1000.31 | 90 | 529.57 | 1529.88 |
| 46 | 9 | 100 | 850 | 850 | 1.37 | 1164.50 | 15 | 7 | 85 | 989.83 | 90 | 524.03 | 1513.85 |
| 46 | 10 | 100 | 73 | 73 | 1.37 | 100.01 | 13 | 9 | 100 | 100.01 | 100 | 50.01 | 150.02 |
| 46 | 11 | 100 | 281 | 281 | 1.37 | 384.97 | 10 | 12 | 100 | 384.97 | 100 | 192.49 | 577.46 |
| 46 | 12 | 100 | 422 | 422 | 1.37 | 578.14 | 10 | 12 | 100 | 578.14 | 100 | 289.07 | 867.21 |
| 46 | 13 | 100 | 676 | 676 | 1.37 | 926.12 | 10 | 12 | 100 | 926.12 | 100 | 463.06 | 1389.1 |

AMERICAN RIVER
AREA 6 - WEST SACRAMENTO
1987 / 1988
FLOOD ELEVATION 19'

| BOOK | PAGE | BK/P6% | BK/PGV | (%)(VAL) | %INCR | MKT VALUE | ELEV. | DEPTH | %DAM STRU | STRU DAM | %DAM CONT | CONT DAM | TOTAL |
|-------|------|--------|--------|----------|-------|--------------|-------|-------|--------------|-------------|--------------|-------------|---------|
| 46 | 14 | 100 | 3154 | 3154 | 1.37 | 4320.98 | 10 | 12 | 100 | 4320.98 | 100 | 2160.49 | 6481.47 |
| 46 | 15 | 100 | 614 | 614 | 1.37 | 841.18 | 10 | 12 | 100 | 841.18 | 100 | 420.59 | 1261.77 |
| 46 | 16 | 100 | 948 | 948 | 1.37 | 1298.76 | 10 | 12 | 100 | 1298.76 | 100 | 649.38 | 1948.14 |
| 46 | 17 | 100 | 110 | 110 | 1.37 | 150.70 | 10 | 12 | 100 | 150.70 | 100 | 75.35 | 226.05 |
| 46 | 18 | 100 | 147 | 147 | 1.37 | 201.39 | 10 | 12 | 100 | 201.39 | 100 | 100.70 | 302.09 |
| 46 | 19 | 100 | 149 | 149 | 1.37 | 204.13 | 10 | 12 | 100 | 204.13 | 100 | 102.07 | 306.20 |
| 46 | 21 | 100 | 252 | 252 | 1.37 | 345.24 | 15 | 7 | 85 | 293.45 | 90 | 155.36 | 448.81 |
| 46 | 22 | 100 | 276 | 276 | 1.37 | 378.12 | 15 | 7 | 85 | 321.40 | 90 | 170.15 | 491.56 |
| 46 | 23 | 100 | 1115 | 1115 | 1.37 | 1527.55 | 15 | 7 | 85 | 1298.42 | 90 | 687.40 | 1985.82 |
| 46 | 24 | 100 | 1003 | 1003 | 1.37 | 1374.11 | 10 | 12 | 100 | 1374.11 | 100 | 687.06 | 2061.17 |
| 46 | 25 | 100 | 469 | 469 | 1.37 | 642.53 | 15 | 7 | 85 | 546.15 | 90 | 289.14 | 835.29 |
| 46 | 26 | 100 | 245 | 245 | 1.37 | 335.65 | 15 | 7 | 85 | 285.30 | 90 | 151.04 | 436.35 |
| 46 | 27 | 100 | 1079 | 1079 | 1.37 | 1478.23 | 10 | 12 | 100 | 1478.23 | 100 | 739.12 | 2217.35 |
| 46 | 28 | 100 | 395 | 395 | 1.37 | 541.15 | 10 | 12 | 100 | 541.15 | 100 | 270.58 | 811.73 |
| 46 | 29 | 100 | 3226 | 3226 | 1.37 | 4419.62 | 15 | 7 | 85 | 3756.68 | 90 | 1988.83 | 5745.51 |
| 46 | 30 | 100 | 1732 | 1732 | 1.37 | 2372.84 | 15 | 7 | 85 | 2016.91 | 90 | 1067.78 | 3084.69 |
| TOTAL | | | 85265 | | | 1.17E+5 | | | | 1.13E+5 | | 57280.39 | 1.71E+5 |

Sacramento River Study
(South Sacramento)
Property Appraisal
(In Thousands of Dollars)

| BOOK | BK/PG% | BK/PGVA | (%)(VAL) | %INCR | MKT. VALUE | DEPTH FT. | %DAM STRU | STRU DAM | %DAM CONT. | CONT. DAM |
|---------|--------|-----------|-----------|-------|---------------|--------------|--------------|-------------|---------------|--------------|
| 29 | 100 | 115.430 | 115.430 | 1.37 | 158,139 | 9 | 46 | 72,744 | 81 | 64,046 |
| 30 | 100 | 269,260 | 269.260 | 1.37 | 368,886 | 9 | 46 | 169,688 | 81 | 149,399 |
| 31 | 100 | 375.550 | 375.550 | 1.37 | 514,504 | 12 | 46 | 236.672 | 81 | 208,374 |
| 47 | 100 | 53.209 | 53.209 | 1.37 | 72,896 | 9 | 46 | 33.532 | 81 | 29,523 |
| 48 | 100 | 42.943 | 42.943 | 1.37 | 58.832 | 4 | 35 | 20.591 | 60 | 17,650 |
| 52 | 100 | 26.615 | 26.615 | 1.37 | 36.462 | 6 | 41 | 14.949 | 74 | 13.491 |
| 53 | 100 | 23.310 | 23.310 | 1.37 | 31,935 | 6 | 41 | 13.093 | 74 | 11,816 |
| 35 | 96 | 78.274 | 75,143 | 1.37 | 102,946 | 4 | 35 | 36.031 | 60 | 30,884 |
| 24 | 81 | 87.194 | 70.627 | 1.37 | 96,759 | 5 | 39 | 37.736 | 68 | 32,898 |
| 16 | 58 | 71.594 | 41.524 | 1.37 | 56.888 | 4 | 35 | 19.911 | 60 | 17,066 |
| 49 | 54 | 117.255 | 63.334 | 1.37 | 86.767 | 4 | 35 | 30.368 | 60 | 26.030 |
| 41 | 53 | 36.857 | 19.534 | 1.37 | 26.762 | 4 | 35 | 9.367 | 60 | 8.029 |
| 36 | 41 | 42.908 | 17.592 | 1.37 | 24,101 | 4 | 35 | 8.435 | 60 | 7.230 |
| 119 | 29 | 92.591 | 26.851 | 1.37 | 36.786 | 9 | 46 | 16.922 | 81 | 14.898 |
| TOTALS: | | 1,433.020 | 1,220.922 | | 1,672.663 | | | 720.039 | | 631,334 |

PUBLIC & SEMI-PUBLIC DAMAGES

| | NATOMAS | SOUTH SACRAMENTO | WEST SACRAMENTO | |
|--|------------|------------------|-----------------|------------|
| | | | (1) | (2) |
| PRIVATE STRUC. VALUE (\$1,000,000) 1986 | 527 | 1,673 | 759 | 759 |
| DAMAGES (\$1,000,000) 1986 | 523 | 720 | 610 | 494 |
| PRIVATE CONTENT VALUE (\$1,000,000) 1986 | 264 | 836 | 380 | 380 |
| DAMAGES (\$1,000,000) 1986 | 263 | 631 | 315 | 259 |
| % TOTAL DAMAGES/ TOTAL VALUE | 99 | 54 | 81 | 66 |
| PUBLIC VALUE (STRUC. & CONT.) | 75,000/AC. | 86,000/AC. | 99,000/AC. | 99,000/AC. |
| PUBLIC ACRES | 4390 | 1049 | 1020 | 1020 |
| TOTAL PUBLIC VALUE (1,000,000) | 329 | 90 | 101 | 101 |
| PUBLIC DAMAGES (\$1,000,000) | 325 | 48 | 82 | 67 |

(1) LEVEE FAILURE IN SUB-AREA A

(2) LEVEE FAILURE IN SUB-AREA B

APPENDIX F

*DETAILED METHODOLOGY FOR PROJECTION
OF LOSS OF LIFE*

NUMBER OF POTENTIAL FATALITIES IN THE 100-YEAR FLOOD PLAIN
UNDER THE THREE FLOOD SCENARIOS

| | 1988 Existing Level of Flood Protection | 1989- 1992 | 1992 w/o Stabilization | 1992 w/ Stabilization | 1992- 1997 | 1997 w/ Additional Upstream Storage & Levee Improvements | 1997-2010 Annual Increment ¹ |
|----------------------------|--|---------------|---------------------------|--------------------------|---------------|---|---|
| Natomas | 138 | 17 | 155 | 3 | .37 | 4 | .51 |
| The Pocket Area | 183 | 10 | 193 | 4 | .12 | 4 | .0003 |
| Remaining Flood Plain Area | 29 | 2 | 31 | 31 | 2 | 34 | .47 |
| Total | 350 | 29 | 379 | 38 | 3 | 42 | 1 |

¹ The annual increment is the additional number of fatalities each year after 1997 that additional upstream storage and levee improvement projects are not implemented.

SOURCE: U.S. COE and EIP Associates.

APPENDIX G

***EXCERPT FROM THE CITY OF SACRAMENTO PUBLIC WORKS
DEPARTMENT'S EMERGENCY PLAN -- FOUR STAGED WARNING
AND RESPONSE SYSTEM***

City Manager's Emergency Warning and Response

Because flooding affects everyone the City Manager office has established the following criteria, which is the same material as covered in the "Natomas area imminent/actual flooding document".

Anytime the elevation of the water in the river or stream is higher than the land elevation, there is a potential for flooding. Citizens can help protect themselves, their family and their property by planning ahead and being prepared. In a flood or any other emergency, citizens should listen to radio or television for emergency instructions and information. The Emergency Broadcast System control radio station in this area is KFBK (1530 AM).

Emergency warning and response will be based on a four-staged warning and response system. These stages, and the actions to be taken in each, are based on existing and forecasted weather conditions, river/stream levels, relative height of water in relation to designed freeboard, and any significant conditions, i.e., sloughing, boils, etc. The stages and corresponding actions to be taken are described as follows:

River/Stream Advisory

The stage at which the river/stream is rising and elevation of river/stream is one foot below river/stream warning stage.

This stage is declared when weather conditions cause the river/stream to rise to near flood levels and no sign of improved weather conditions are forecast.

Actions to be taken:

- a. Citizens will be advised to the possibility of flooding conditions and asked to take precautionary measures.
- b. Critical facilities, businesses, schools, etc., will be advised to implement precautionary measures and reduce activity to essential activities only.

River/Stream Warning Stage

The stage at which patrol of flood control project levees becomes mandatory, or the stage at which flow occurs into bypass areas from project overflow wiers.

This stage is declared when water levels in the canal or river/stream has increased one foot above the river/stream advisory stage and no sign of improved weather conditions are forecast.

Actions to be taken:

- a. General public will be warned of the possibility of flooding conditions and asked to take precautionary measures. They will be cautioned that the river/stream is continuing to rise.
- b. Critical facilities, businesses, schools, etc., will be warned to implement precautionary measures and reduce all activities to essential activities only. They will be cautioned that the river/stream is continuing to rise.

Project Flood Alert Stage

The stage at which the flow in the flood control project is at maximum design capacity (U.S. Corps of Engineers "Project Flood Plane"). At this level there is a minimum freeboard equal to design freeboard below the top of levees.

This stage is declared when water level in the canal or river/stream has reached the dsigned freeboard (normally 3' to 5' below the top of the levee). Flood warning indicates the water has reached a relatively dangerous level and flooding conditions are likely to occur in portions of the area. No sign of improved weather conditions are forecase. This stage would also be declared when a levee has sloughed, or dirty water boils of significant size and/or number are occurring, even if the river/stream levels were lower than this stage.

Actions to be taken:

- a. General public will be warned of potential flooding conditions and recommended to begin evacuation of the area.
- b. Recommend closure of all schools, non-essential businesses, closure and/or evacuation of critical facilities, and the cancellation of sporting events and public gatherings.

Flood Danger Stage

The stage at which the flow in the flood control project is greater than maximum design capacity and where there is extreme danger with threat of significant hazard to life and property in the event of levee failure.

This stage is declared when the water level has encroached 1/3 into the design freeboard requirement and no improved weather conditions are forecast; severe sloughing occurs, or boils containing debris or other material are observed, or boils of significant size and/or number are observed.

Actions to be taken:

- a. All non-essential personnel will be directed to evacuate the area immediately.
- b. If not already declared, a "Local Emergency" will be declared.
- c. Entry into the impacted area will be restricted to emergency personnel only.
- d. Increased security of the evacuated area will be implemented.

NOTE:

Severe and/or unexpected conditions may necessitate moving from RIVER/STREAM ADVISORY STAGE to FLOOD DANGER STATE, without declaring a RIVER/STREAM WARNING STAGE or a FLOOD ALERT STAGE, caused by unanticipated rise in river/stream levels due to increased release from Folsom Dam, or increased flow resulting from the Cross Canal and/or other tributaries to the north or east.

APPENDIX H

TIME INNUNDATION STUDIES

SUMMARY REPORT

TIME - INUNDATION STUDY
POCKET AREA

SUBMITTED TO



CITY OF SACRAMENTO

MARCH 1989



**Boyle
Engineering
Corporation**

consulting engineers / architects

Suite 250 North
100 Howe Avenue
Sacramento, California 95825

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FAX 916 / 483-7999

Boyle Engineering Corporation

CONSULTING ENGINEERS, INC. 1111

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Department of Public Works
City of Sacramento
1391 - 35th Avenue
Sacramento, CA 95822-2911

March 14, 1989

City of Sacramento, Time-Inundation Study, Pocket Area

Dear Mr. Barboza:


We are pleased to submit the final report for the subject study. I have included four copies of the subject report for your use.

This study analyzed the potential flooding in the Pocket Area from a levee failure. Each of three locations along the north, west, and south levee portions was studied to provide time-inundation scenarios.

Generally, the results indicate that major portions of the Pocket Area would be flooded in less than two hours, seriously hampering evacuation efforts within an hour. Further flooding would occur up to 10 feet in depth within about 7 hours.

Please feel free to call me if you have any questions or comments concerning this report.

BOYLE ENGINEERING CORPORATION



Joseph P. Alessandri
Project Manager

SC-S49-400-10/cl

CITY OF SACRAMENTO TIME-INUNDATION STUDY POCKET AREA 1

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CITY OF SACRAMENTO TIME-INUNDATION STUDY POCKET AREA

INTRODUCTION

This study has been prepared at the request of the City of Sacramento by a task order under contract NO. 87-295, Levee Certification, dated June 15, 1988, between Boyle Engineering Corporation and the City of Sacramento.

BACKGROUND

The Pocket Area of the City of Sacramento is located about 5 miles south and slightly west of downtown Sacramento between a loop of the Sacramento River and Interstate 5. The area is surrounded on the north, west, and south sides by the left bank levee of the river and on the east side by Interstate 5. The area is primarily residential with only minor commercial development. The Pocket Area is densely populated and consists of a mixture of single and multiple family housing units. The area is approaching buildout and development of all available land is nearly complete.

In May 1988 the Corps of Engineers issued an initial appraisal report on the Sacramento River Flood Control System ⁽¹⁾ in which the left bank levee of the Sacramento River between Miller Park and the town of Freeport was reported to have structural stability problems. This report, in conjunction with the damage that occurred along the levee during the February 1986 flood, prompted the City of Sacramento to request that Boyle Engineering prepare flood inundation maps delineating area, depth of flooding, and timing related to potential Sacramento River flood events along the Pocket Area.

METHOD OF ANALYSIS

The analytic method used to determine the time verses inundation relationship for the Pocket Area assumed that a portion of the levee surrounding the area failed during a flood on the Sacramento River. The stage-discharge relationship of the hydrograph at the point of failure was computed and the breach characteristics defined. The breach in the levee was assumed to form instantaneously and the river flow would immediately divide between the levee breach and the downstream river channel. The flow through the breach was then routed across the study area to determine the time verses inundation relationship for each failure. These procedures were repeated for three separate breach locations assuming that only one breach would occur during an event.

DATA AND ASSUMPTIONS

Flood

The 100-year flood was assumed to cause a failure of the levee. This flood was developed by the COE for the reach of the Sacramento River between the "I" Street Bridge and the town of Freeport ⁽²⁾. Other floods, with return periods of 10, 20 and 50-years, were investigated and were found to be only slightly smaller than the 100-year flood. After discussion with Bruce Barbosa of the City of Sacramento, it was decided that only the 100-year flood would be used in this investigation.

Although the flow remains the same, the river stage drops as the flow progresses downstream. Because of this, stage-discharge rating curves were developed for each of the levee failure sites by linearly interpolating between the two USGS gaging stations located at the "I" Street Bridge, River Mile (RM) 59.4, and at the Freeport Bridge, RM 46.0. The rating curves are shown on Plate 6 and the corresponding values are presented in Table 2. The stage-discharge values for the two gage sites were obtained from supporting data for the COE 1988 Flood Insurance Study on the City of Sacramento ⁽³⁾.

Breach Location

The levee stability reports ^(1,4) by the COE were reviewed to determine the location of potential levee failure sites along the left bank of the river surrounding the Pocket Area. From the above reports the left bank is reported to be structurally unstable between RM 54.0 and RM 48.0. The levee failure sites were determined based on the recommendations and conclusions in these reports. The first site was located near Oak Hall Bend at RM 53.4. This area was chosen because it is near the beginning of the reach described as structurally unstable and the river makes a sharp bend to the west which increases the potential for erosion. The next site was located near Garcia Bend on the west side of the Pocket Area at RM 51.3 and was chosen because of instability and the resulting low factor of safety for this location as determined in the COE report. The third site was located at RM 49.0 near the unnamed bend at the southwest corner of the Pocket Area. This site was chosen because it is located at the end of the structurally unstable reach and near the south side of the study area. The location of the three sites, shown on Plate 2, represent levee failures from the north, west, and south sides, and cover the structurally unstable area described in the COE appraisal report.

Breach Failure

The levee was assumed to fail on the rising limb of the flood hydrograph when the river reached a discharge of 116,600 cfs, the maximum flow that occurred during the flood of February 1986. The COE model, "XRATE", was used to divide the flow between the downstream river channel and the levee breach. This model was reviewed and discussed under the initial task order of the levee Certification contract in a report by Boyle Engineering Corporation ⁽⁵⁾. The model uses the stage-discharge rating curve for the river and the breach discharge data of the levee failure to determine the flow division between the river channel and the breach. The model assumes the stage at the beginning of the flow division must be the same for both directions and that the sum of the two flows will equal the flow in the river before the division occurred. This method was verified by using the method discussed in Ven Te Chow's book, "Open-Channel Hydraulics," ⁽⁶⁾. The two

methods were in close agreement and the COE method was used because of the simplicity and ease of computation compared to the method discussed by Chow.

Breach Discharge

The breach discharge was based on the broad-crested weir discharge equation, $Q = CLH^{(1.5)}$, where:

Q is the discharge in cubic feet per second.

C is the weir coefficient.

L is the length of the levee breach in feet.

H is the hydraulic depth of the water in feet.

The breach coefficient, "C", was assumed to be 2.70. This is the same breach coefficient used by the COE for the Garcia Bend levee failure at RM 51.3 in the 1988 Flood Insurance Study on the City of Sacramento ⁽³⁾.

The levee breach length, "L", was determined to be 500 feet. This length was based on a discussion with Mel Yarwood, Floodplain Management Section, Sacramento District, COE, in which he stated that the COE has found the average breach length to be 500 feet based on an analysis of actual levee failures. This was substantiated in a preliminary report by the City of Sacramento ⁽⁷⁾ in which 500 feet was found to be the average breach length based on an analysis of data from historical failures.

The hydraulic depth, "H", of the water is defined as the difference between the elevation of the bottom of the breach and the elevation of the water surface. The breach was assumed to fail instantaneously down to the landside toe of the levee. The elevation of the toe of the levee, which is the bottom of the breach, was estimated from USGS 7 1/2 minute quadrangle maps for each of the levee failure sites. The elevation of the water surface varies with time and the discharge through the breach.

Routing Considerations

The inundation volumes in the Pocket Area were determined from USGS 7 1/2 minute quadrangle maps. Inundation areas were planimetered at contour elevations of 5, 10, 15, and 20 feet. All areas stopped at Freeport Blvd., the eastward limit of the study area. The storage volume of the area was then computed as the average of two adjacent contour areas times the difference in elevation between the contours. The lowest elevation in the study area is 4 feet as determined from the USGS maps and was assumed to have zero area.

Interstate 5 was assumed not to block the flow of water to the east side of the highway since there are adequate underpasses that will allow flow to move to the east side. In addition, the area of I-5 south of the Florin Road overcrossing down to the South Land Park Drive overcrossing is very low, an elevation of 6 to 7 feet, and water will flow over the freeway to the east side as the depth of water increases in the Pocket Area.

The outflow from the Pocket Area was assumed to flow over Freeport Blvd. in the area around and south of Meadowview Road where the Southern Pacific Railroad embankment has been cut down to ground level. A width of 800 feet and a surface elevation of 14.0 feet with no erosion of the opening during the study period were assumed. These are the same parameters and assumptions used by the COE in the Garcia Bend levee failure analysis for the 1988 Flood Insurance Study on the City of Sacramento which seem to be reasonable. Since the study was limited to the area west of Freeport Blvd., the time at which the overflow begins was assumed to be the end of the study. Storage in the inundated area was assumed to build with a minimal outflow of 1 to 3 cfs until Freeport Blvd. would overtop at an elevation of 14.0 feet.

RESULTS AND CONCLUSIONS

General Summary

The results of the Time-Inundation Study for the Pocket Area are shown on Plate 1 and in Table 1. The inundation maps are presented on Plates 3, 4, and 5. As indicated, there are only minor differences in the final depths between the three levee failure sites. Since the levee breaks are representative of breaks on the north, west and south sides, a levee failure anywhere around the Pocket Area will have similar consequences. The high degree of development currently existing in the area is not shown on the USGS maps. Although these maps were revised in 1980, most of the development in this area has occurred after that date.

In the area directly below a break houses will be damaged or destroyed and possible loss of life may occur. The initial flow through the breach will be channelized by the streets which are generally lower in elevation than the surrounding land and because of the restriction to overland flow caused by houses, fences, and shrubbery in the highly developed residential area. This will quickly cause the streets to become impassable which will have a major impact on the ability to evacuate the population. The rapid flooding of the area will limit the evacuation time to less than two hours for most of the area and less than one hour for a good portion of the area. Heavy traffic in the area can be expected and access into and out of the area for emergency vehicles will be impeded. Florin Road, located near the center of the Pocket Area and a major access route to and from the area, will be one of the first streets flooded which will have a severe impact on traffic movement out of the area. Three to four hours after the levee failure Interstate 5 will be flooded south of Florin Road stopping traffic flow in both the north and south directions and further restricting emergency vehicle access. The Pocket Area has very few exit routes and only one alternate route. These, from north to south, are Riverside Blvd., 43rd Avenue, Gloria Drive, 56th Avenue, Florin Road, South Land Park Drive, and Pocket/Meadowview Road. The only alternate route out of the area is the maintenance road on top of the levee which is not readily accessible from within the Pocket Area.

The area east of I-5 is not in the Pocket Area but will be affected by a levee failure in the Pocket Area. As can be seen on the inundation maps, the area between I-5 and Freeport Blvd. will be flooded as will the area north to Sutterville Road on the south side of William Land Park. Since these areas are at the edge of the inundated area the water will not be as deep as in the Pocket Area. Most of the area outside the Pocket Area will have one or more hours for evacuation.

Levee Failure near Oak Hall Bend at RM 53.4

This location was chosen because it is on the north side of the Pocket Area at the beginning of the structurally unstable area identified by the COE. In addition, the Sacramento River makes a sharp bend to the west at this point which increases the potential for erosion of the levee. The construction of the levee at this point is typical of the levee along the north side of the study area and the effects of a levee failure anywhere along the north side would be similar to the results for this location. The primary flow path would initially be southward through Seymour Park to the area just south of Florin Road near the central portion of the area where the flow will collect and begin to fill the area. The northeast corner of the study area will be flooded immediately and access to the exits at Riverside Blvd. and 43rd Avenue from most of the study area will be cutoff by the breach outflow. Within the first hour approximately 40% of the Pocket Area will be flooded and the exits at Gloria Drive, 56th Avenue, Florin Road and South Land Park Drive will be inaccessible. Pocket Road, the only exit for the southern portion of the area, will be flooded within two hours leaving only the levee maintenance road as an exit from the area. In 3 to 4 hours water will begin to flow over I-5 stopping traffic in both the north and south bound directions. In 7 to 8 hours more than 70 % of the area will be flooded to an elevation of 10 feet. In slightly less than 16 hours just under 95% of the Pocket Area will be flooded to an elevation of 14 feet, when water will begin to overtop Freeport Blvd., and have a maximum depth of approximately 10 feet near the center of the area.

Levee Failure near Garcia Bend at RM 51.3

This location, just north of Garcia Bend, was identified in the COE report as having a low factor of safety because of structural instability problems and was recommended for immediate remedial repair. This area, although somewhat more poorly constructed, is typical of the western portion of the levee and the results of this analysis are representative of a failure along the west side of the Pocket Area. The flow path would be generally eastward, initially following the local streets, toward the central portion of the basin where it will spread out and eventually back up against I-5. In just under an hour more than 35% of the area will be flooded and the water will have spread north and south along I-5 cutting off access to the exits at 56th Avenue, Florin Road, and South Land Park Drive. The exit at Pocket Road will be cut off within 2 hours and in approximately 3 hours the exit at Gloria Drive to the north will be flooded blocking this exit. In approximately 3 to 4 hours water will begin to flow over I-5 interrupting traffic in both the north and south directions. After 7 to 8 hours nearly 75% of the basin will be covered with water and the 43rd Avenue exit will be partially or completely flooded. In 15 to 16 hours the flood level will reach an elevation of 14 feet and flow will begin over Freeport Blvd. At this point between 90% and 95% of the basin will be inundated. The levee road, north and south of the break, and Riverside Blvd. in the upper northeast corner will allow some egress from this area.

Levee Failure near the southwest corner at RM 49.0

The third breach site was chosen because it is located about midway along the last stretch of levee identified as structurally unstable by the COE. The levee in this region is relatively uniform and the results of the analysis are typical of a failure occurring anywhere along the southwest corner of the Pocket Area. The breach flow will initially flood the small, low lying area around River Lake before overflowing into the central portion of the basin. In approximately one hour 40% of the basin will be flooded to an elevation of 5 feet. The access to the exits at 56th Avenue, Florin Road,

and South Land Park Drive will be blocked and the area between the breach and I-5 will be separated from the rest of the Pocket Area. Within 1 to 2 hours the access to the exit at Pocket Road will be flooded and the southeast area will be nearly enclosed. The levee maintenance road will provide an exit but access to the top of the levee in this area is limited. By the end of 7 or 8 hours the basin will be flooded to an elevation of 10 feet and between 70% and 75% of the basin will be covered by water. Access to the exit at Riverside Blvd. will be impaired or completely blocked leaving only the levee road to provide egress from the area. In just over 15 hours approximately 95% of the basin will be inundated to an elevation of 14 feet and water will begin flowing over Freeport Blvd.

REFERENCES

have

1. "Sacramento River Flood Control System Evaluation - Initial Appraisal Report - Sacramento Urban Area," U.S. Army Corps of Engineers - Sacramento District, Sacramento, California, May 1988.
2. "Position Paper - Sacramento City/County F.I.S. - Sacramento River, Freeport to Verona," unpublished paper, U.S. Army Corps of Engineers - Sacramento District, Sacramento, California, December 1988.
3. "Supporting Data for the 1988 Flood Insurance Study on the City of Sacramento," unpublished data, U.S. Army Corps of Engineers - Sacramento District, Sacramento, California, 1988.
4. "Levee Investigation, Reclamation Districts 537 and 900 (R.D. 537 and 900) and Maintenance Areas 4 and 9 (M.A. 4 and 9), Sacramento River, Sacramento Bypass and Yolo Bypass, Yolo and Sacramento Counties, California," Wahler Associates, September 1987.
5. "Summary Report - Initial Coordination and Review Work Task," Boyle Engineering Corporation, Sacramento, California, February 1989.
6. Ven Te Chow: "Open-Channel Hydraulics," McGraw-Hill Book Company, New York, 1959, pp 512-516.
7. "South Natomas Levee Breach Scenarios - Confidential Preliminary Report," City of Sacramento - Flood and Sewer Division, Sacramento, California, 1988.

TABLE 1

POCKET AREA TIME-INUNDATION STUDY
TIME VS. WATER SURFACE ELEVATION

| LEVEE FAILURE AT RM 53.4 | | | LEVEE FAILURE AT RM 51.3 | | | LEVEE FAILURE AT RM 49.0 | | |
|--------------------------------|--------------------------|----------------------------|--------------------------------|----------------------------|--------------------------|--------------------------------|----------------------------|--|
| TIME (HOURS) | ELEVATION (FEET-NGVD) | MAXIMUM DEPTH (FEET) | ELEVATION (FEET-NGVD) | MAXIMUM DEPTH (FEET) | ELEVATION (FEET-NGVD) | ELEVATION (FEET-NGVD) | MAXIMUM DEPTH (FEET) | |
| 0 | 4.00 | 0.00 | 4.00 | 0.00 | 4.00 | 4.00 | 0.00 | |
| 1 | 5.10 | 1.10 | 5.11 | 1.11 | 5.12 | 5.12 | 1.12 | |
| 2 | 5.86 | 1.86 | 5.91 | 1.91 | 5.93 | 5.93 | 1.93 | |
| 3 | 6.63 | 2.63 | 6.72 | 2.72 | 6.74 | 6.74 | 2.74 | |
| 4 | 7.41 | 3.41 | 7.52 | 3.52 | 7.55 | 7.55 | 3.55 | |
| 5 | 8.17 | 4.17 | 8.32 | 4.32 | 8.36 | 8.36 | 4.36 | |
| 6 | 8.94 | 4.94 | 9.12 | 5.12 | 9.17 | 9.17 | 5.17 | |
| 7 | 9.71 | 5.71 | 9.93 | 5.93 | 9.98 | 9.98 | 5.98 | |
| 8 | 10.29 | 6.29 | 10.45 | 6.45 | 10.48 | 10.48 | 6.48 | |
| 9 | 10.76 | 6.76 | 10.93 | 6.93 | 10.98 | 10.98 | 6.98 | |
| 10 | 11.23 | 7.23 | 11.42 | 7.42 | 11.47 | 11.47 | 7.47 | |
| 11 | 11.71 | 7.71 | 11.92 | 7.92 | 11.97 | 11.97 | 7.97 | |
| 12 | 12.18 | 8.18 | 12.42 | 8.42 | 12.47 | 12.47 | 8.47 | |
| 13 | 12.66 | 8.66 | 12.91 | 8.91 | 12.98 | 12.98 | 8.98 | |
| 14 | 13.14 | 9.14 | 13.41 | 9.41 | 13.48 | 13.48 | 9.48 | |
| 15 | 13.62 | 9.62 | 13.92 | 9.92 | 13.99 | 13.99 | 9.99 | |
| 16 | 14.11 | 10.11 | 14.42 | 10.42 | 14.50 | 14.50 | 10.50 | |

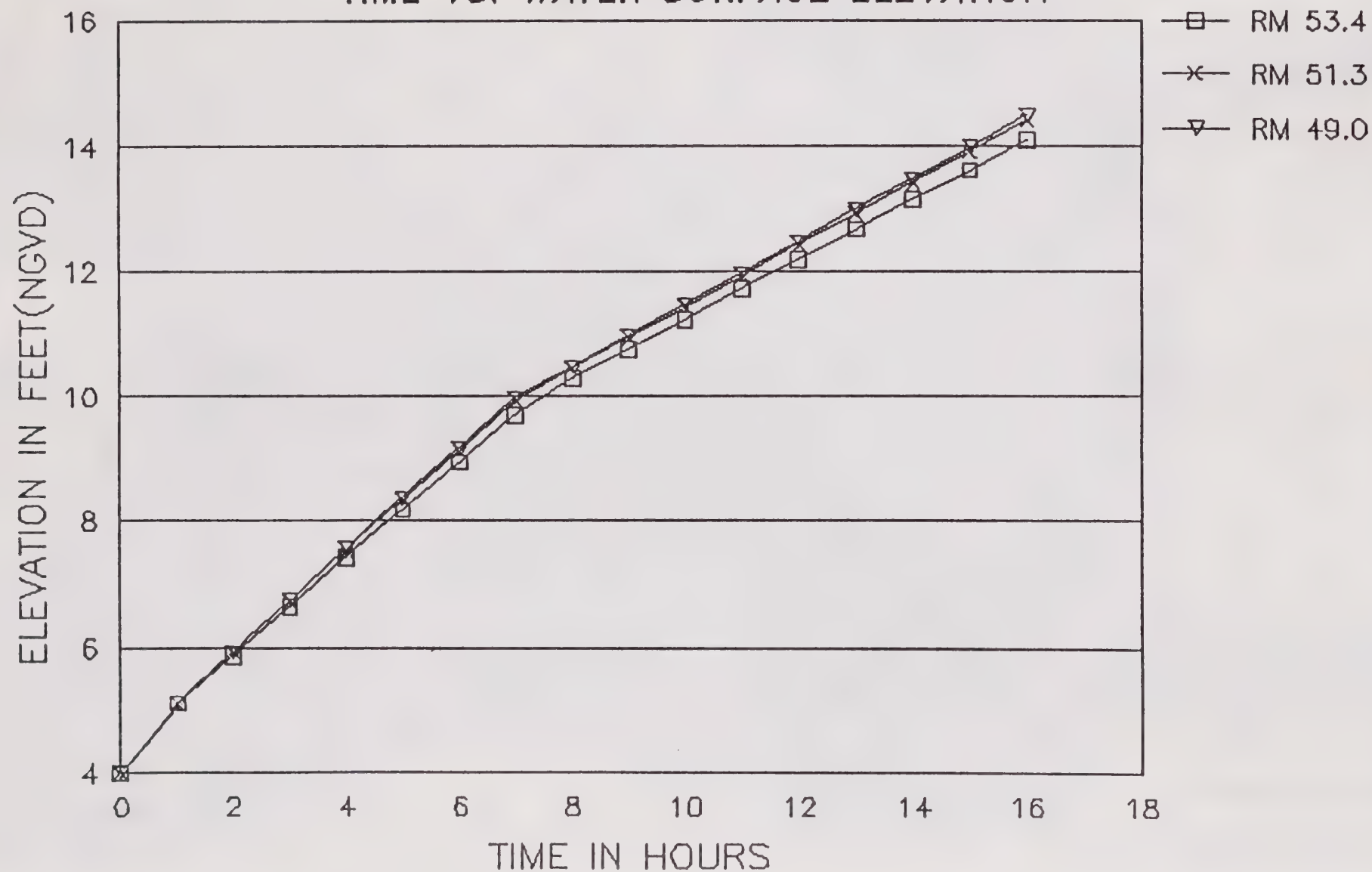
TABLE 2

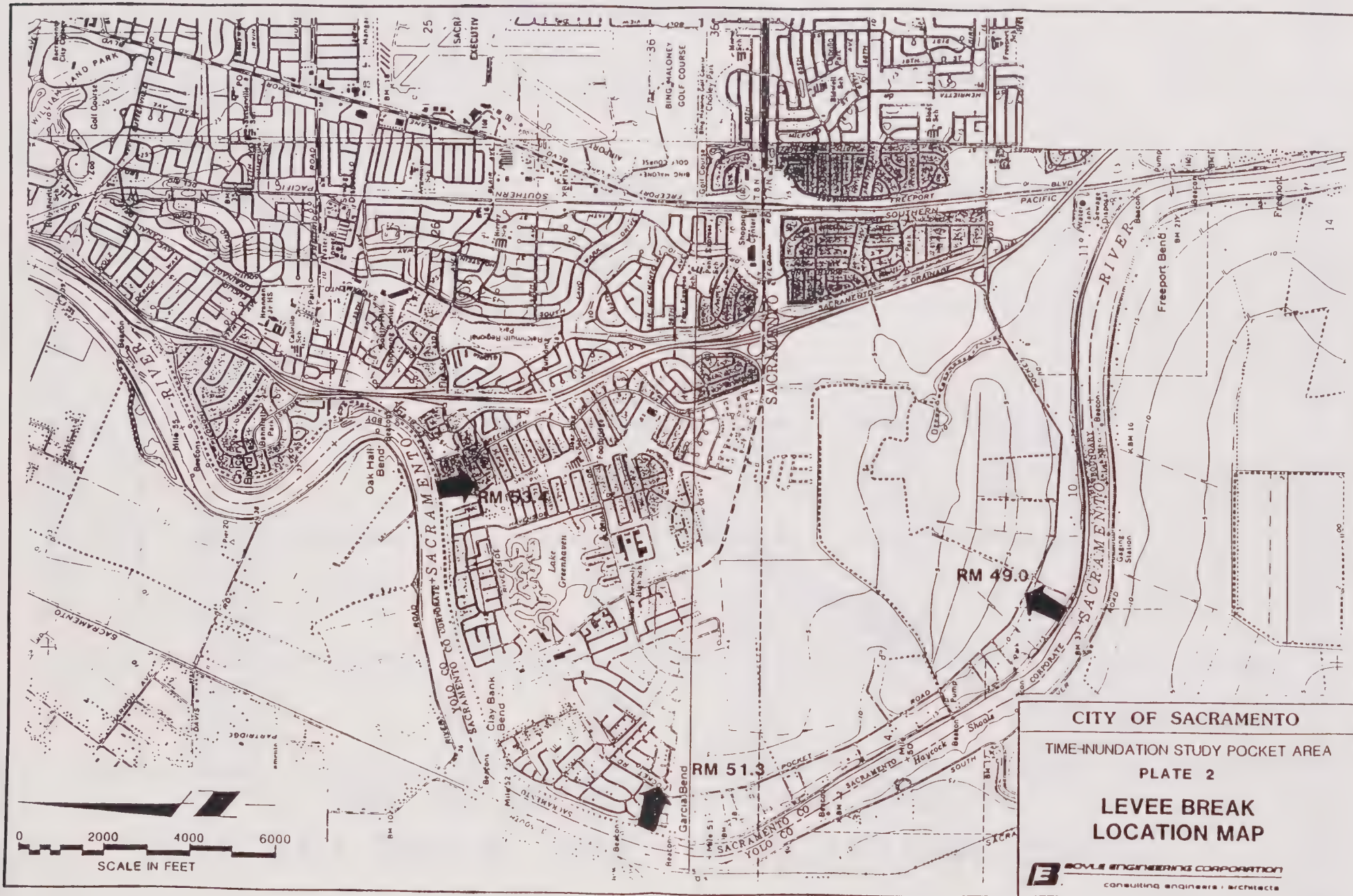
SACRAMENTO RIVER
STAGE VS. FLOW RATING CURVES

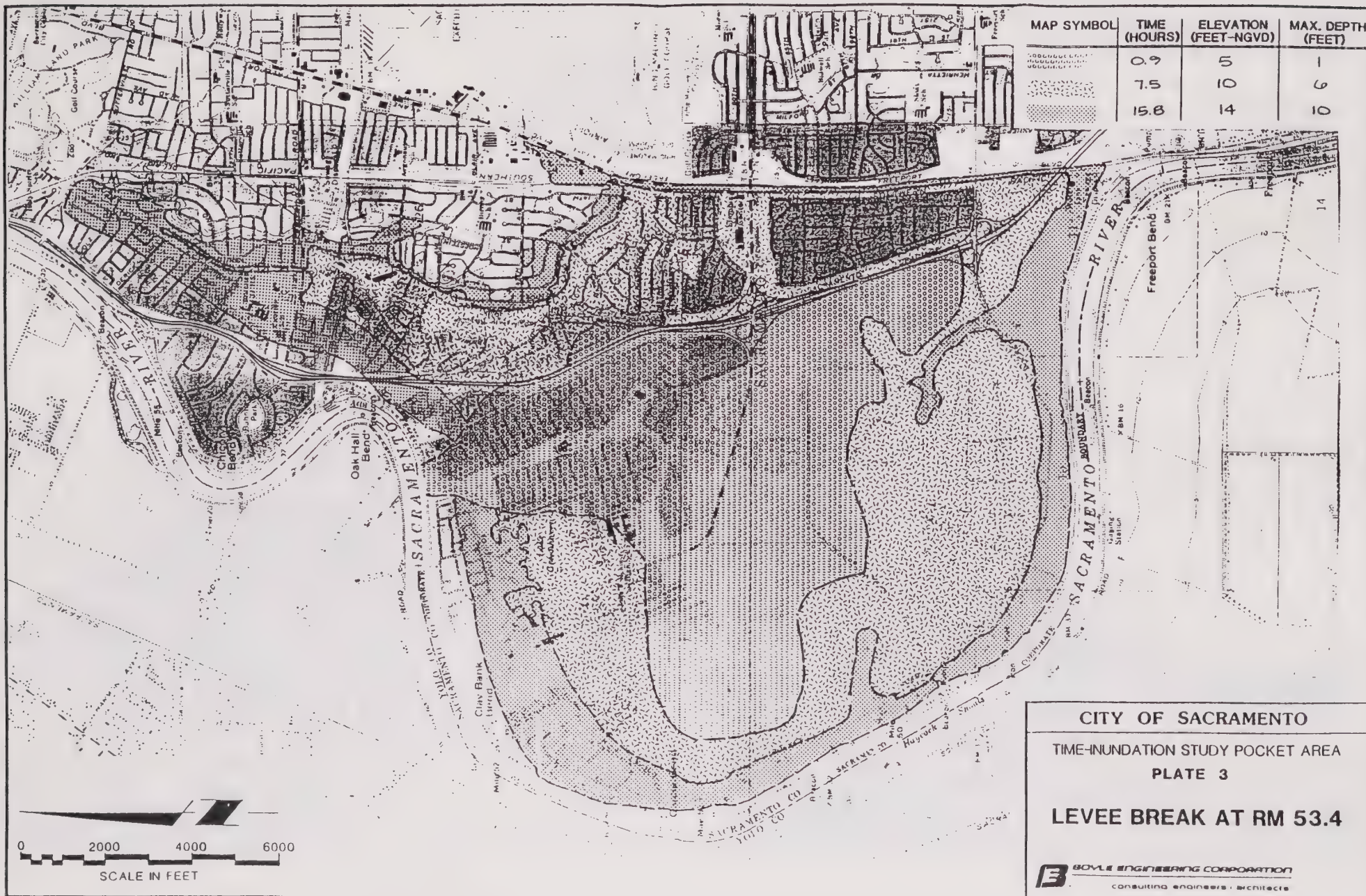
| RIVER FLOW (CFS) | RIVER STAGE (FEET-NGVD) | | | | |
|---------------------|------------------------------|-----------------------------|---------------------------|------------------------------|-----------------------------|
| | I" STREET GAGE RM 59.4 | OAK HALL BEND RM 53.4 | GARCIA BEND RM 51.3 | SOUTHWEST BEND RM 49.0 | FREEPORT GAGE RM 46.0 |
| 60,000 | - | 15.4 | 14.7 | 14.0 | - |
| 65,000 | - | 16.8 | 16.0 | 15.2 | - |
| 70,000 | - | 18.1 | 17.3 | 16.5 | - |
| 75,000 | 22.1 | 19.5 | 18.7 | 17.8 | - |
| 80,000 | 23.3 | 20.9 | 20.0 | 19.1 | 17.9 |
| 85,000 | 24.6 | 22.1 | 21.3 | 20.3 | 19.1 |
| 90,000 | 25.9 | 23.4 | 22.5 | 21.5 | 20.3 |
| 95,000 | 27.1 | 24.5 | 23.6 | 22.6 | 21.4 |
| 100,000 | 28.4 | 25.7 | 24.8 | 23.7 | 22.4 |
| 105,000 | 29.7 | 26.8 | 25.8 | 24.7 | 23.3 |
| 110,000 | 30.8 | 27.8 | 26.8 | 25.6 | 24.1 |
| 115,000 | - | 28.6 | 27.3 | 26.3 | 25.0 |
| 116,600 | - | 28.8 | 27.5 | 26.4 | 25.1 |
| 120,000 | - | 29.2 | 27.7 | 26.5 | - |

POCKET AREA TIME-INUNDATION STUDY

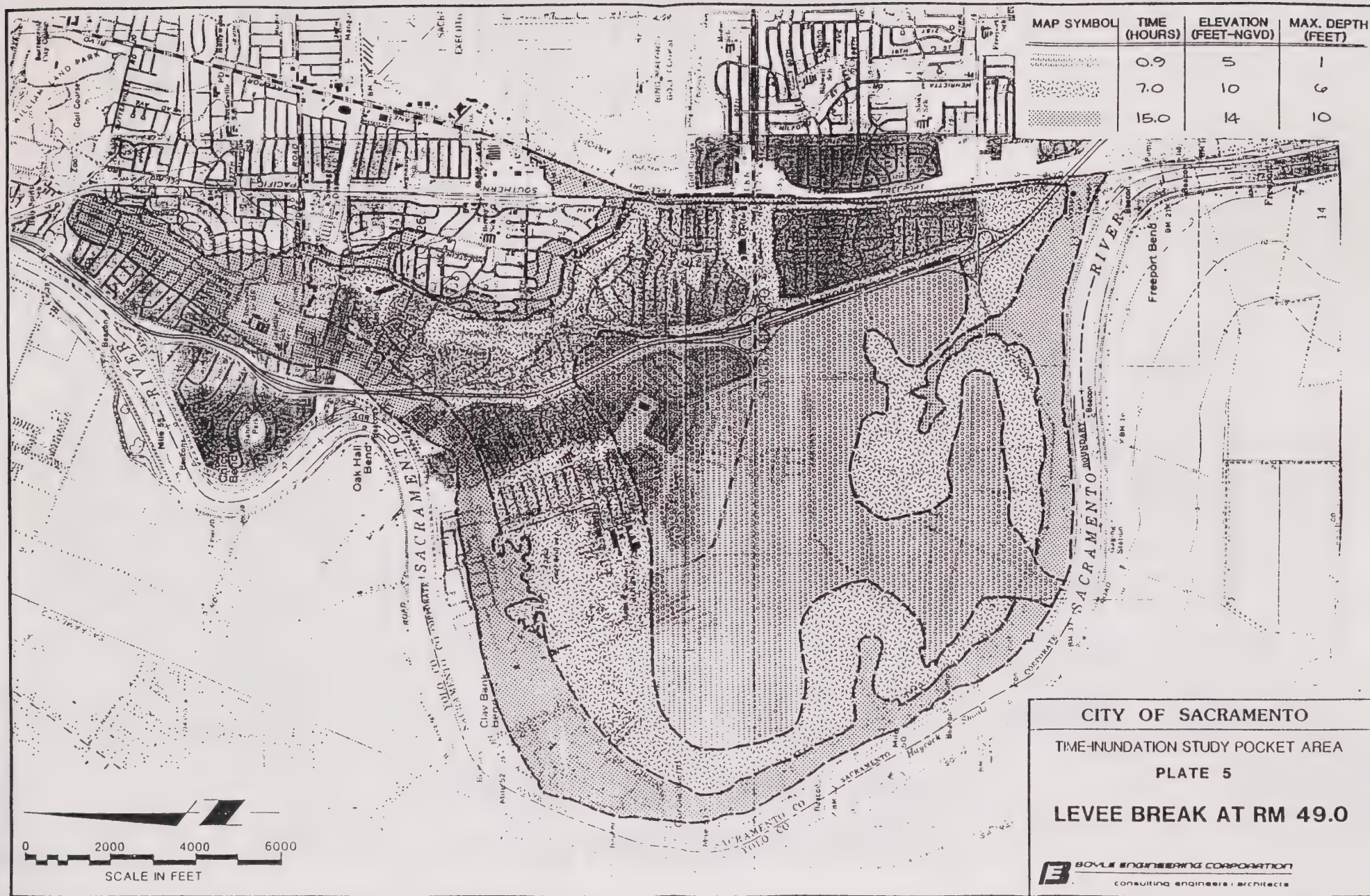
TIME VS. WATER SURFACE ELEVATION



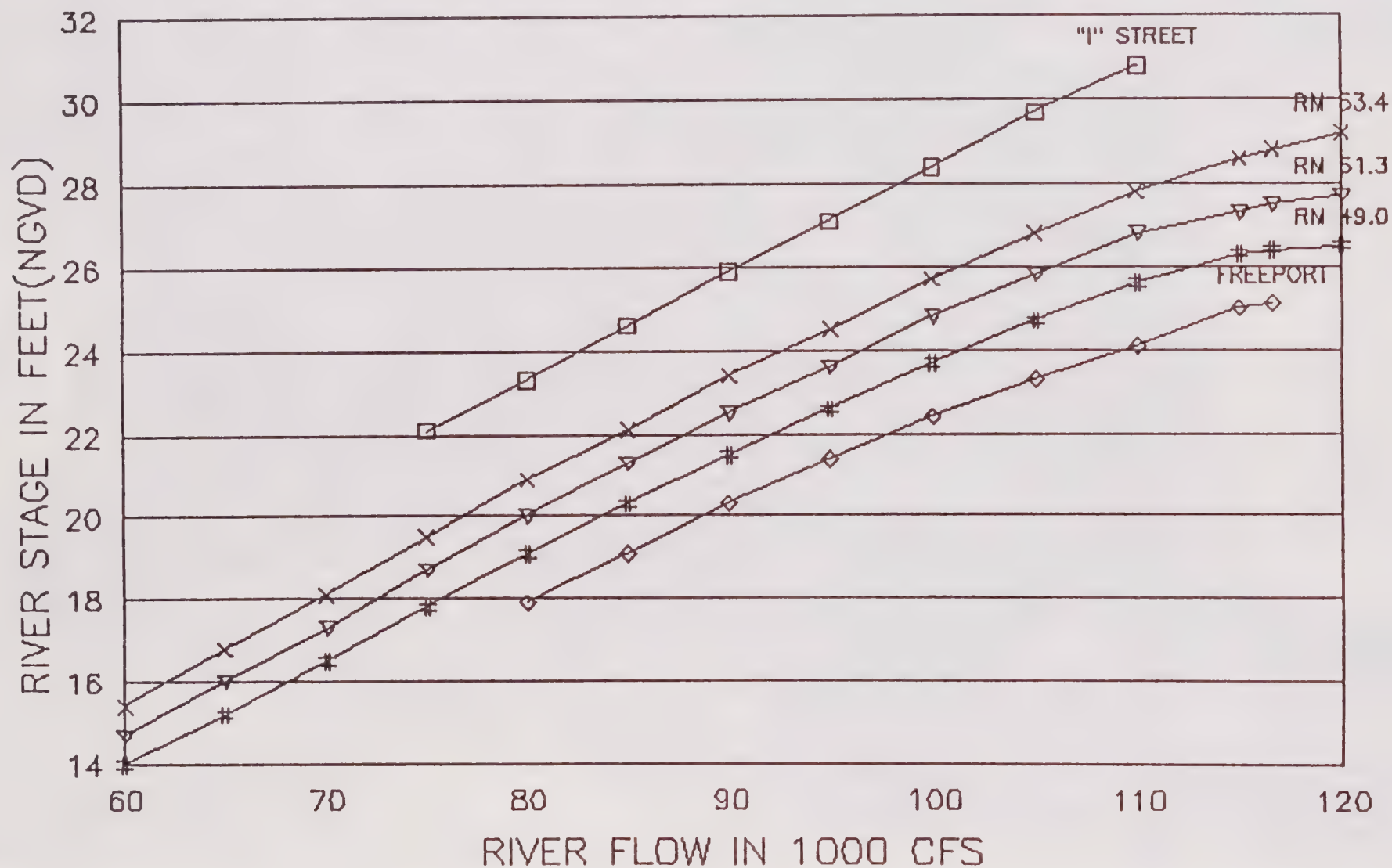








SACRAMENTO RIVER STAGE VS. FLOW RATING CURVES



Appendix 1
THREAT SUMMARY

IMMINENT/ACTUAL FLOODING CONDITIONS
(LEVEE OVERTOPPING/FAILURE)
NATOMAS AREA

1. GENERAL INFORMATION

Flooding conditions can occur in the Natomas area as a result of any of several scenarios, ranging from levee overtopping to partial or complete levee failure. Overtopping of the East Main Drainage Canal may be classed as a slow-rise flood and be preceded by a warning time of up to several hours, whereas a failure in levee integrity anywhere along the American or Sacramento River levees would result in extensive flooding with minimum warning time. The flooding would still be of a slow-rise nature as opposed to a flash flood. In either scenario, timely warning is of utmost importance and will require significant resources to accomplish. Additionally, significant resources (personnel) will be required to conduct search and notification activities, assist critical facilities in evacuation of personnel, secure utilities, conduct traffic control, and regulate and control entry into the threatened or impacted areas.

A catastrophic levee failure, depending on the size and location of the rupture, could exceed the response capability of the city. Damage control and disaster relief support would be required from other local governmental, private and volunteer organizations, and from the state and federal government. Mass evacuation of the inundation areas would be essential. Extensive search and rescue operations may be required to assist trapped, injured, ill or non-ambulatory persons. Emergency medical care, food, and temporary shelter would be required for displaced persons. Public health (sanitation) would be a major concern. Many families may be separated, particularly if the failure should occur during working hours. A personal inquiry or locator system, available through the Red Cross, would be essential. These and other emergency operations could be seriously hampered by the loss or disruption of communications, damage to transportation routes, and the disruption of public utilities and other essential services.

2. Special Situation

The South Natomas area is divided into two man made basins, both of which are south of the I-80 freeway and north of the Garden Highway. The least populated basin, West Natomas, is on the west side of I-5 and is mainly commercial development and agricultural land, as is the area north of I-80 between the East Main Drainage Canal and I-5 (99). The South Natomas area, east of I-5, is primarily residential, shopping and office complexes, with a population during peak periods of approximately 40,000.

The Southeast Natomas basin is surrounded by the East Main Drainage Canal levee on the east, the Garden Highway levee on the south and is bounded by Highway 80 to the north and Interstate 5 to the east. The East Main Drainage Canal levee has the least freeboard of the local levee system, therefore is subject to first overtopping and the Garden Highway levee to the south and west needs structural improvements.

An overtopping or catastrophic levee failure can occur on any of the levees. Should all of the levees retain their integrity during periods of extreme weather, an overtopping is most likely to occur in the vicinity of Arcade Creek. The flood hazard maps contained in this threat summary provide possible scenarios reflecting general flood inundation information **only** and are not areas predicted to fail or be of specific concern. The breaks reflected (100 or 500 feet) are immediate and therefore do not present a real time element for exact inundation times. Furthermore, the times do not take into account time involved in flood fighting or other mitigating actions.

3. EMERGENCY WARNING AND RESPONSE

Anytime the elevation of the water in the river or stream is higher than the land elevation, there is a potential for flooding. Citizens can help protect themselves, their family and their property by planning ahead and being prepared. In a flood or any other emergency, citizens should listen to radio or television for emergency instructions and information. The Emergency Broadcast System control radio station in this area is KFBK (1530 AM).

Emergency warning and response will be based on a four-staged warning and response system. These stages, and the actions to be taken in each, are based on existing and forecasted weather conditions, river/stream levels, relative height of water in relation to designed freeboard, and any significant conditions, i.e., sloughing, boils, etc. The stages and corresponding actions to be taken are described as follows:

RIVER/STREAM ADVISORY - The stage at which the river/stream is rising and elevation of river/stream is one foot below river/stream warning stage.

This stage is declared when weather conditions cause the river/stream to rise to near flood levels and no sign of improved weather conditions are forecast.

Actions to be taken:

- a. Citizens will be advised to the possibility of flooding conditions and asked to take precautionary measures.
- b. Critical facilities, businesses, schools, etc., will be advised to implement precautionary measures and reduce activity to essential activities only.

RIVER/STREAM WARNING STAGE - The stage at which patrol of flood control project levees becomes mandatory, or the stage at which flow occurs into bypass areas from project overflow weirs.

This stage is declared when water levels in the canal or river/stream has increased one foot above the river/stream advisory stage and no sign of improved weather conditions are forecast.

Actions to be taken:

- a. General public will be warned of the possibility of flooding conditions and asked to take precautionary measures. They will be cautioned that the river/stream is continuing to rise.
- b. Critical facilities, businesses, schools, etc., will be warned to implement precautionary measures and reduce all activities to essential activities only. They will be cautioned that the river/stream is continuing to rise.

PROJECT FLOOD ALERT STAGE - The stage at which the flow in a flood control project is at maximum design capacity (U.S. Corps of Engineers "Project Flood Plane"). At this level there is a minimum freeboard equal to design freeboard below the top of levees.

This stage is declared when water level in the canal or river/stream has reached the designed freeboard (normally 3' to 5' below the top of the levee). Flood warning indicates the water has reached a relatively dangerous level and flooding conditions are likely to occur in portions of the area. No sign of improved weather conditions are forecast. This stage would also be declared when a levee has sloughed, or dirty water boils of significant size and/or number are occurring, even if the river/stream levels were lower than this stage.

Actions to be taken:

- a. General public will be warned of potential flooding conditions and recommended to begin evacuation of the area.
- b. Recommend closure of all schools, non-essential businesses, closure and/or evacuation of critical facilities, and the cancellation of sporting events and public gatherings.

FLOOD DANGER STAGE - The stage at which the flow in the flood control project is greater than maximum design capacity and where there is extreme danger with threat of significant hazard to life and property in the event of levee failure.

This stage is declared when the water level has encroached 1/3 into the design freeboard requirement and no improved weather conditions are forecast; severe sloughing occurs, or boils containing debris or other material are observed, or boils of significant size and/or number are observed.

Actions to be taken:

- a. All non-essential personnel will be directed to evacuate the area immediately.
- b. If not already declared, a "Local Emergency" will be declared.
- c. Entry into the impacted area will be restricted to emergency personnel only.
- d. Increased security of the evacuated area will be implemented.

NOTE:

Severe and/or unexpected conditions may necessitate moving from RIVER/STREAM ADVISORY STAGE to FLOOD DANGER STAGE, without declaring a RIVER/STREAM WARNING STAGE or a FLOOD ALERT STAGE, caused by unanticipated rise in river/stream levels due to increased release from Folsom Dam, or increased flow resulting from the Cross Canal and/or other tributaries to the north or east.

4. CRITICAL FACILITIES

Critical facilities in the Natomas areas which may require special assistance in an imminent or actual flooding situation include -

Schools

| | |
|-------------------------------|----------|
| Rio Tierra Junior High School | |
| 3201 Northstead Drive | 921-3715 |

| | |
|---------------------------|----------|
| Strauch Elementary School | |
| 3141 Northstead Drive | 925-6703 |

| | |
|-------------------------|----------|
| Aletha B. Smythe School | |
| 2781 Northgate Blvd | 925-8566 |

| | |
|-----------------------|----------|
| Natomas Middle School | |
| 3700 Del Paso Road | 925-2702 |

| | |
|----------------------------------|----------|
| American Lakes Elementary School | 924-3565 |
| 2800 Stonecreek Drive | 924-3915 |

| | |
|--------------------------|----------|
| Jefferson School | |
| 2635 Chestnut Hill Drive | 454-8646 |

| | |
|---------------------------------|----------|
| Garden Valley Elementary School | |
| 3601 Northgate Blvd | 922-4432 |

Day Care Centers

| | |
|-------------------------|----------|
| Children's World | |
| 2500 Natomas Park Drive | 922-9827 |

| | |
|--------------------------|----------|
| Merryhill Country School | |
| 1593 Waterwheel Drive | 924-7043 |
| 2401 Northview Drive | 927-8591 |

Day Care Centers (Continued)

| | |
|--|----------------------|
| Discovery Place 501 San Juan Road | 921-5777 |
| Peace Lutheran Preschool 925 San Juan Road | 927-5934 |
| Kids On Campus 2800 Stonecreek Drive 2001 Pebblewood | 924-3915 446-5437 |

Residential Care Facilities

| | |
|--|----------|
| Natomas Guest Home 421 San Juan Road | 925-7180 |
| Mary's Family Home 1217 Garaventa Way | 927-3736 |
| Friendship Home 794 Turnstone Drive | 923-0716 |
| Northgate Residential Care Home 735 Pelican Way | 920-2750 |

Others

| | |
|---|----------|
| Stanford Settlement 450 W. El Camino Ave | 927-1303 |
| New Sports Arena | |

5. EVACUATION ROUTES

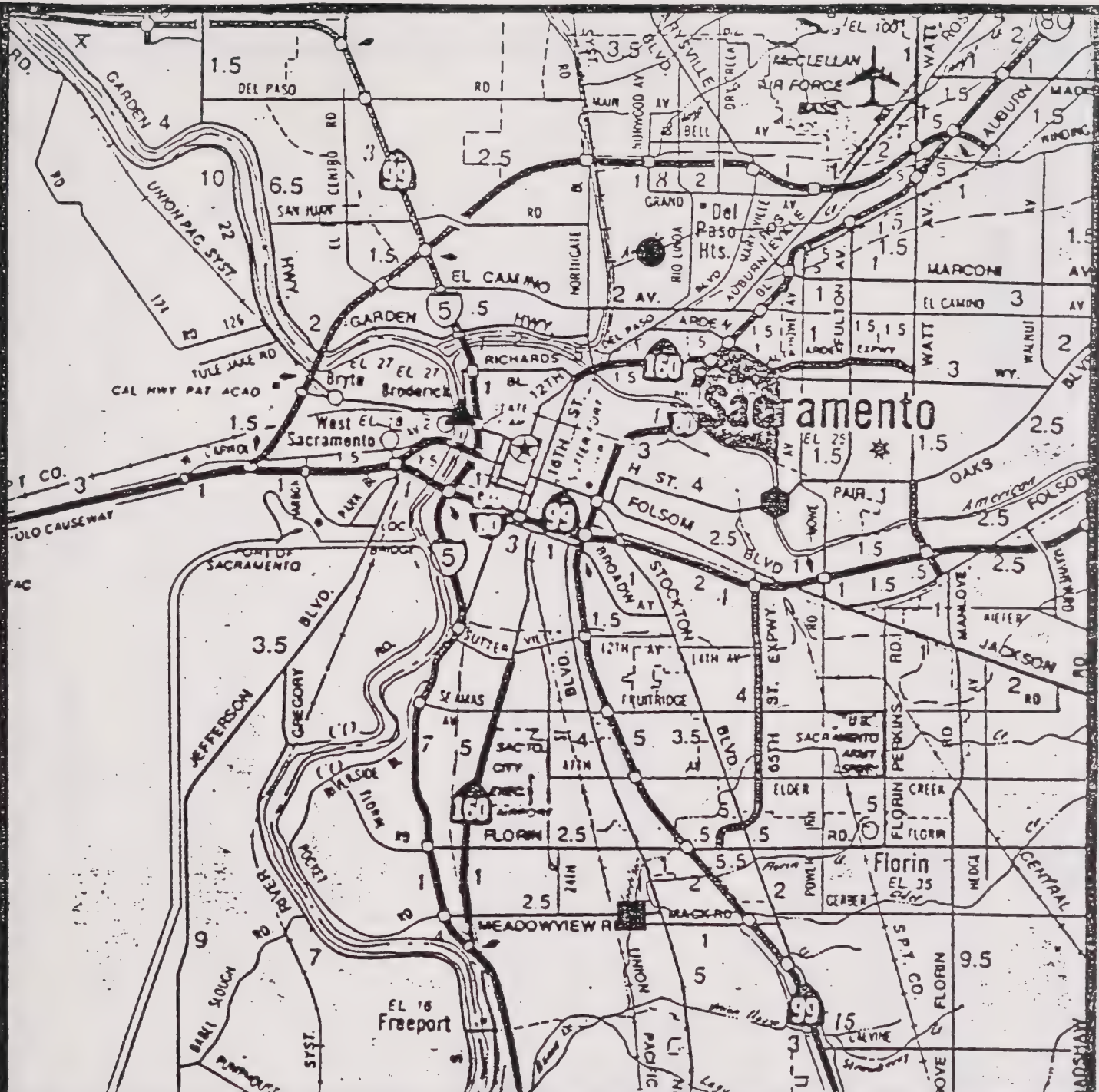
Evacuation routes and other pertinent information relative to movement operations are included in Annex H (**Movement Operations**).

6. EMERGENCY RESPONSE ACTIONS

Emergency response actions associated with the above situations are presented in Appendices A-1 through K-3 to the Annexes in Part Two of this plan.

Attachments:

- Cross Section Diagram - Typical Leveed Stream
 - Morrison Creek
 - Arcade Creek
 - Sacramento River
 - American River
- Flood Hazard Maps - Levee Failure Scenarios

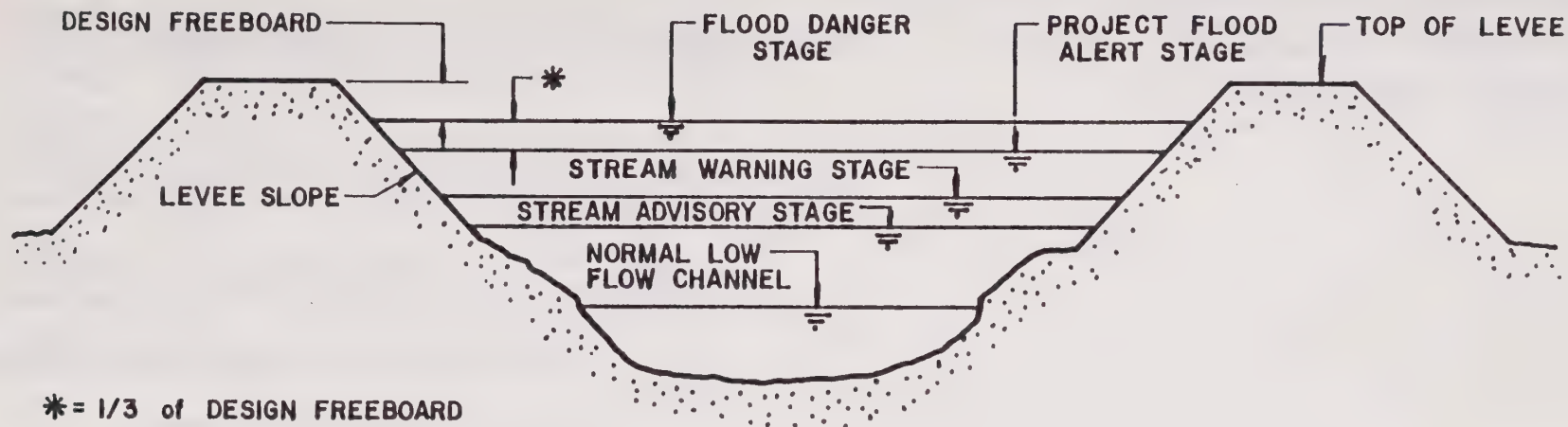


- ARCADE CREEK at NORWOOD AVENUE BRIDGE
- ◆ AMERICAN RIVER at "H" STREET BRIDGE
- ▲ SACRAMENTO RIVER at "EYE" STREET BRIDGE
- MORRISON CREEK at MACK ROAD BRIDGE

CONTROL LOCATION MAP

DR BY : CDB

DEC 8, 1988



| | |
|-------------------------------------|-------------|
| STREAM ADVISORY STAGE ELEVATION | = 12.0 FEET |
| STREAM WARNING STAGE ELEVATION | = 13.0 FEET |
| PROJECT FLOOD ALERT STAGE ELEVATION | = 14.5 FEET |
| FLOOD DANGER STAGE ELEVATION | = 15.5 FEET |
| SOFFET ELEVATION | = 21.2 FEET |

CROSS SECTION - TYPICAL LEVEED STREAM

STREAM ADVISORY - The stage at which the stream is rising and elevation of stream is one foot below stream warning stage.

STREAM WARNING STAGE - The stage at which patrol of flood control project levees becomes mandatory, or the stage at which flow occurs into bypass areas from project overflow weirs.

PROJECT FLOOD ALERT STAGE - The stage at which the flow in a flood controlled project is at maximum design capacity (U.S. Corps of Engineers "Project Flood Plane"). At this level there is a minimum freeboard equal to design freeboard below the top of levees.

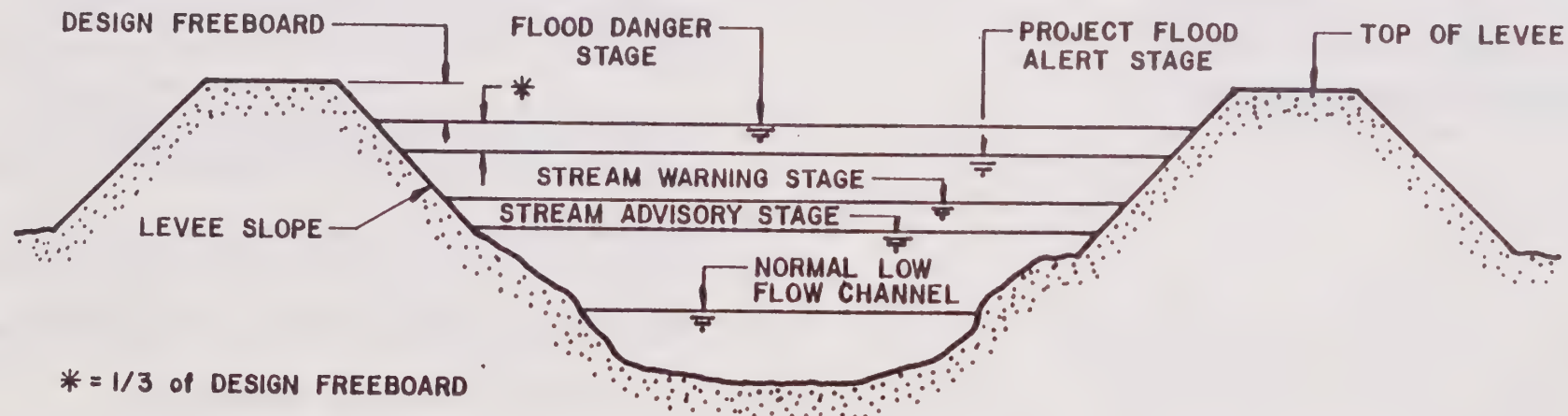
FLOOD DANGER STAGE - The stage at which the flow in the flood controlled project is greater than maximum design capacity and where there is extreme danger with threat of significant hazard to life and property in the event of levee failure.

MORRISON CREEK

at MACK ROAD BRIDGE(MILE 4.384)

DR BY: CDB

DEC 6, 1988



| | |
|-------------------------------------|-------------|
| STREAM ADVISORY STAGE ELEVATION | = 31.8 FEET |
| STREAM WARNING STAGE ELEVATION | = 32.8 FEET |
| PROJECT FLOOD ALERT STAGE ELEVATION | = 34.3 FEET |
| FLOOD DANGER STAGE ELEVATION | = 35.3 FEET |
| SOFFET ELEVATION | = 36.7 FEET |

CROSS SECTION - TYPICAL LEVEED STREAM

STREAM ADVISORY - The stage at which the stream is rising and elevation of stream is one foot below stream warning stage.

STREAM WARNING STAGE - The stage at which patrol of flood control project levees becomes mandatory, or the stage at which flow occurs into bypass areas from project overflow weirs.

PROJECT FLOOD ALERT STAGE - The stage at which the flow in a flood controlled project is at maximum design capacity (U.S. Corps of Engineers "Project Flood Plane"). At this level there is a minimum freeboard equal to design freeboard below the top of levees.

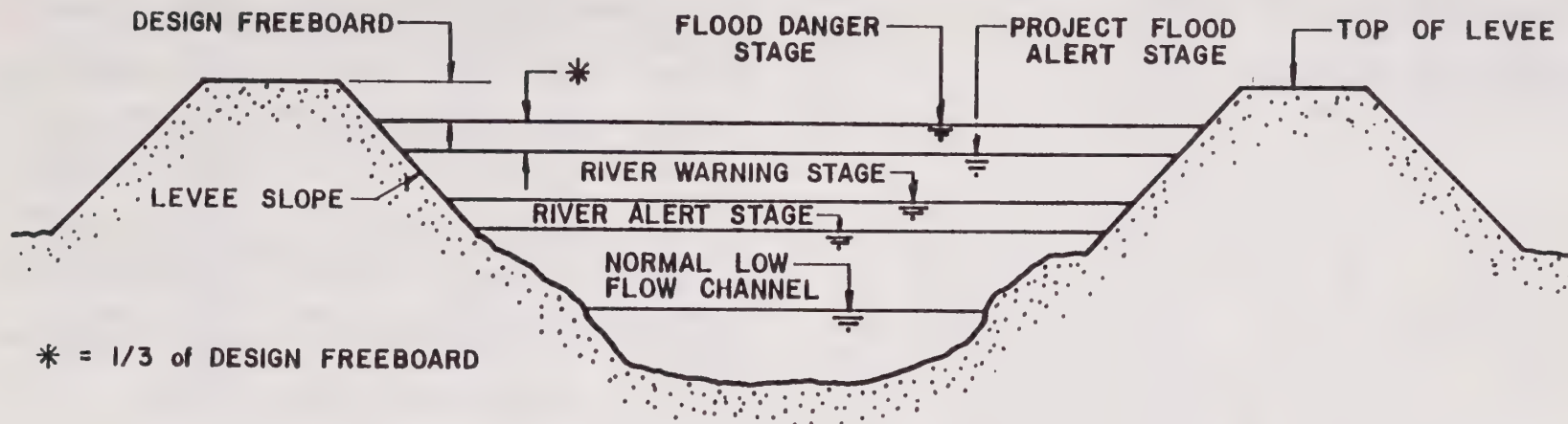
FLOOD DANGER STAGE - The stage at which the flow in the flood controlled project is greater than maximum design capacity and where there is extreme danger with threat of significant hazard to life and property in the event of levee failure.

ARCADE CREEK

at NORWOOD AVENUE(MILE 0.701)

DR. BY: CDB

DEC 6, 1988



| | |
|-------------------------------------|-------------|
| RIVER ADVISORY STAGE ELEVATION | = 24.0 FEET |
| RIVER WARNING STAGE ELEVATION | = 25.0 FEET |
| PROJECT FLOOD ALERT STAGE ELEVATION | = 31.0 FEET |
| FLOOD DANGER STAGE ELEVATION | = 32.0 FEET |

CROSS SECTION - TYPICAL LEVEED RIVER

RIVER ADVISORY - The stage at which the river is rising and elevation of river is one foot below river warning stage.

RIVER WARNING STAGE - The stage at which part of flood control project levees becomes mandatory, or the stage at which flow occurs into bypass areas from project overflow weirs.

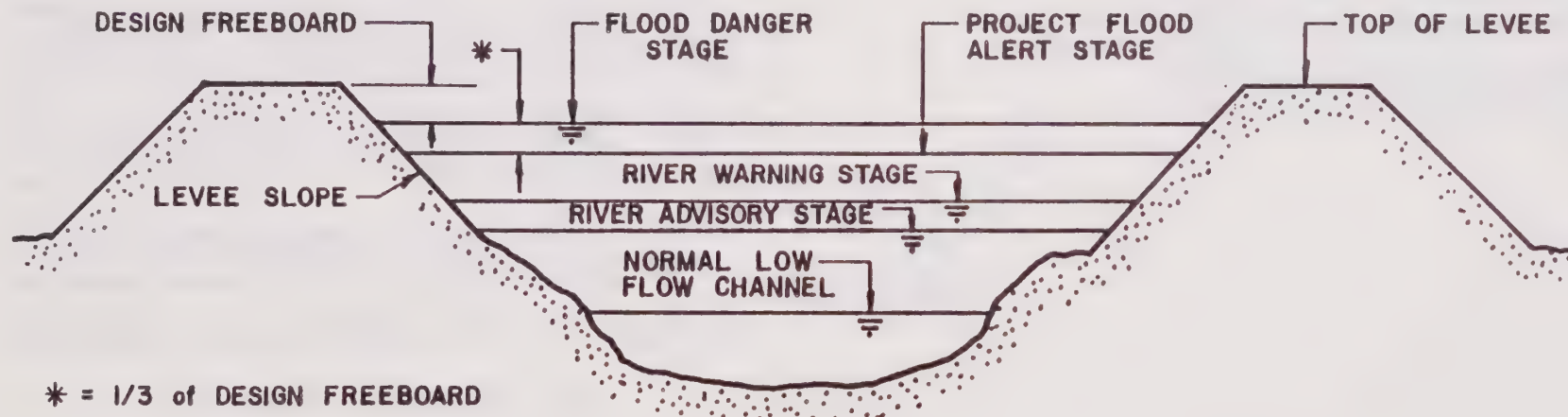
PROJECT FLOOD ALERT STAGE - The stage at which the flow in a flood controlled project is at maximum design capacity (U.S. Corps of Engineers "Project Flood Plane"). At this level there is a minimum freeboard below the top of levees.

FLOOD DANGER STAGE - The stage at which the flow in the flood controlled project is greater than maximum design capacity and where there is extreme danger with threat of significant hazard to life and property in the event of levee failure.

SACRAMENTO RIVER
at "EYE" STREET BRIDGE

DR BY: CDB

DEC 6, 1988



| | |
|-------------------------------------|-------------|
| RIVER ADVISORY STAGE ELEVATION | = 39.0 FEET |
| RIVER WARNING STAGE ELEVATION | = 40.0 FEET |
| PROJECT FLOOD ALERT STAGE ELEVATION | = 42.8 FEET |
| FLOOD DANGER STAGE ELEVATION | = 43.8 FEET |

CROSS SECTION - TYPICAL LEVEED RIVER

RIVER ADVISORY - The stage at which the river is rising and elevation of river is one foot below river warning stage.

RIVER WARNING STAGE - The stage at which partol of flood control project levees becomes mandatory, or the stage at which flow occurs into bypass areas from project overflow weirs.

PROJECT FLOOD ALERT STAGE - The stage at which the flow in a flood controlled project is at maximum design capacity (U.S. Corps of Engineers "Project Flood Plane"). At this level there is a minimum freeboard below the top of levees.

FLOOD DANGER STAGE - The stage at which the flow in the flood controlled project is greater than maximum design capacity and where there is extreme danger with threat of significant hazard to life and property in the event of levee failure.

AMERICAN RIVER
at "H" STREET BRIDGE

DR BY: CDB

DEC 6, 1988



DEPARTMENT OF
PUBLIC WORKS

CITY OF SACRAMENTO
CALIFORNIA

1391-35TH AVENUE
SACRAMENTO, CA
95822-2911

DIVISION OF
FLOOD CONTROL AND SEWERS

916-449-5271

FLOOD SENARIO PRESENTATION

The following assumptions were made in calculating the time elements shown in the various senarios. They are as follows:

1. A break would suddenly occur.
2. The time of impact for the break would be calculated using 100 feet and 500 feet wide breaks. (The levee break at Rio Linda in 1986 was approximately 200 feet wide.)
3. The effect of a FLOOD FIGHT effort would not be considered in the analysis.
4. The flow down the American River would be 180,000 cubic feet per second (cfs) with an approximate water surface elevation in the vicinity of the mouth of the Natomas East Main Drainage Canal of 34.0 feet (elevations are the National Geodetic Vertical Datum).

Please Note the flood senarios should be considered valid only if the assumed flood conditions are realized during a major flood event. The selection of these break locations were random and consequently there is no guarantee that the break/breaks will actually occur at these locations.

The South Natomas Area was broken into two sub-areas for the purposes of these analysis. The name of each area is the South East Natomas Area and the South West Natomas Area.

THEREFORE, WITH THE ABOVE UNDERSTANDING, THIS CAN BE CONSIDERED A "WORST CASE" REVIEW.

ANALYSIS

The four locations, which were chosen for the 100 ft. and 500 ft. levee break scenarios are as follows:

- Location 1: American River at Garden Highway, between River Plaza Drive and Truxel Road.
- Location 2: Natomas East Main Drain (NEMD) at Arcade Creek.
- Location 3: Sacramento River at Gateway Oaks Drive.
- Location 4: Sacramento River at Orchard Lane.

Southeast Natomas (Location 1 and Location 2)

Generally the West Natomas Basin is higher than the Southeast Natomas Basin by an average of 1-2 feet. The flood waters of either West Natomas or Southeast Natomas should not cross I-5 easterly or westerly before exiting northward over the lower freeway I-80. Southeast Natomas has more total containment capacity due to 9 and 10 foot street elevations over 20% of the entire Southeast Natomas basin. Flood elevations are controlled by Freeway I-80 for both basins, exiting at crown elevation of 15 ft. Consequently, at the time of exit, flood depths of up to 2-6 feet will exist, over approximately 40% of the Southeast Natomas.

Location 1 was chosen due to high velocities and possibility for scouring. It was assumed that this levee break analysis was representative of any break possible between I-5 eastward to the Natomas East Main Drain, with regards to the determined water surface elevations and time of fillings. Generally, the breakout will follow Bannon Creek Slough and channel through low-lying streets flowing in a northerly direction, to the lowest elevations within the basin.

The following table shows the time of filling to various water surface elevations for both 100 ft. and 500 ft. breakouts:

TABLE I

Location 1 - 100' and 500' Breakouts

| Levee Break Size | Elapsed Time (Hours) | | |
|---------------------|----------------------|--------------|--------------|
| | 1) El. 11.5' | 2) El. 13.0' | 3) El. 15.0' |
| 100' | 1.9 | 5.8 | 8-9 |
| 500' | 0.4 | 1.2 | 2-3 |

- 1) 20% of the streets are flooded (1.5'-2' deep)
- 2) 30% of the streets are flooded (1.5'-3' deep)
- 3) At elevation 15.0, 40% of the total area is flooded and the basin begins to weir flow northward over Freeway I-80.

NOTE: For detailed calculations and assumptions see Appendix 2.
For contour map of flow v's time see Figure 1B.

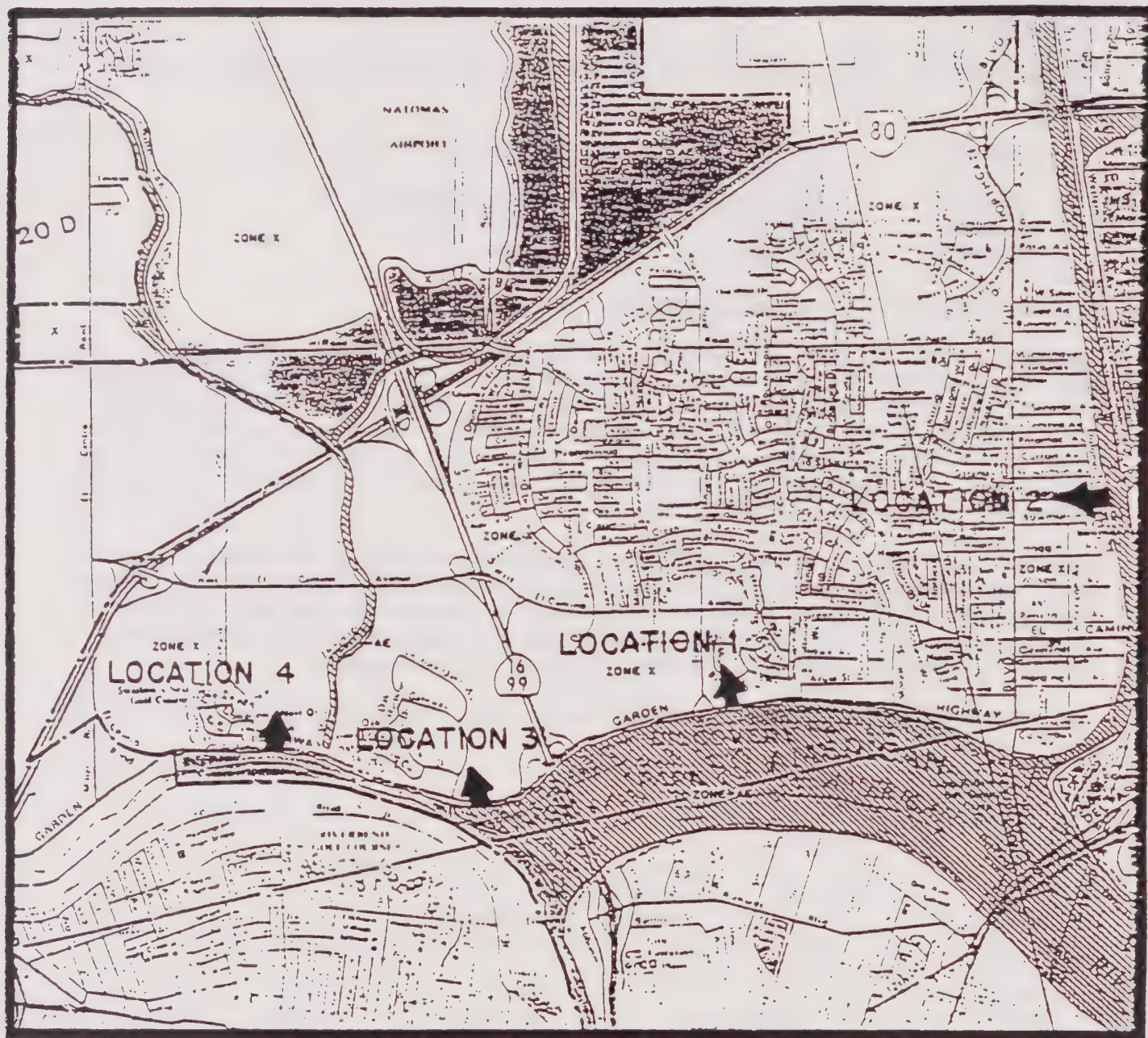
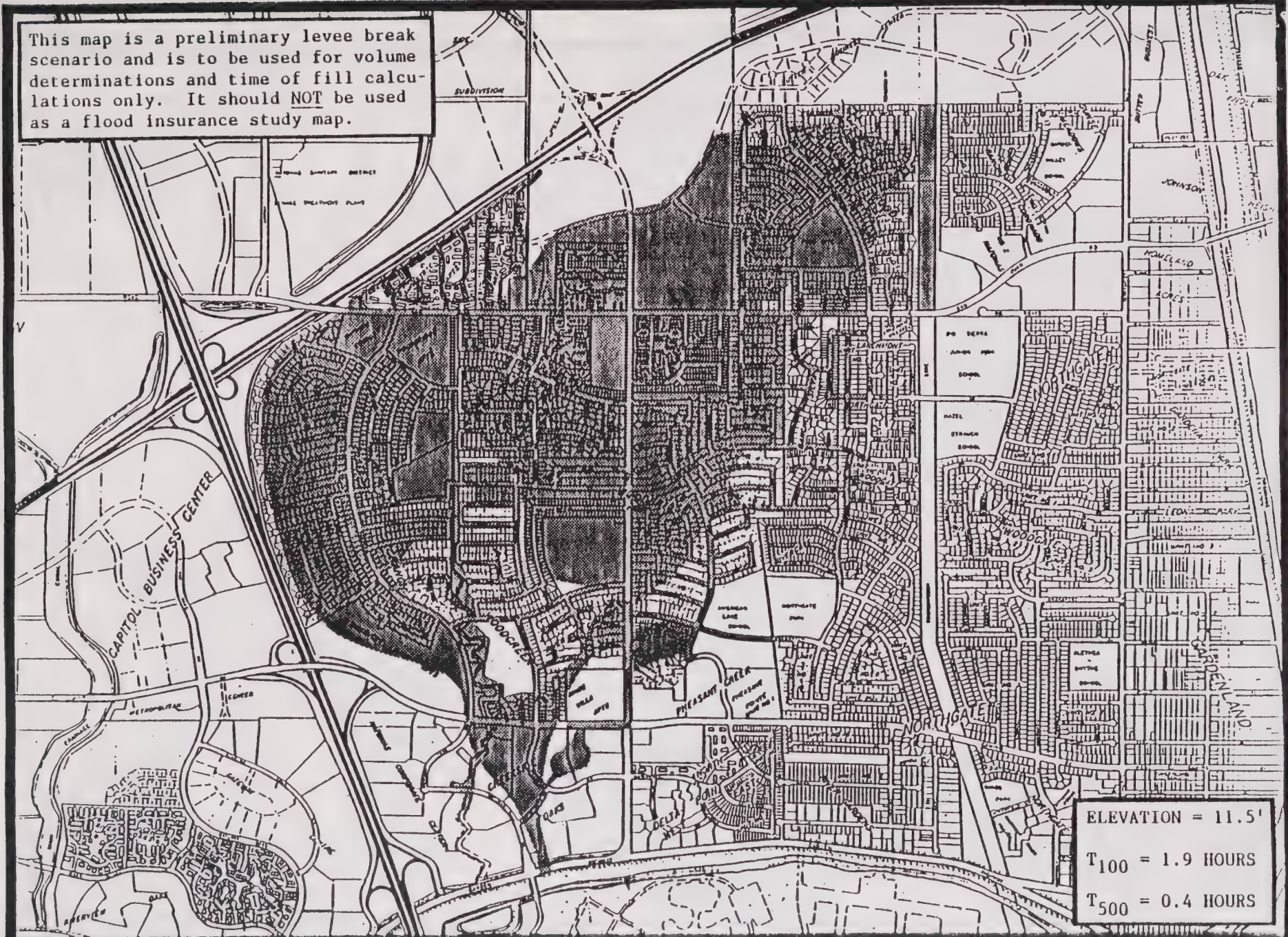


FIGURE 1A

LEVEE BREAK LOCATION MAP

This map is a preliminary levee break scenario and is to be used for volume determinations and time of fill calculations only. It should NOT be used as a flood insurance study map.

FIGURE 1B-LOCATION I LEVEE BREAK



CHECKED BY: M. REID 7/8/88

PREPARED BY: C. BRESSEM

This map is a preliminary levee break scenario and is to be used for volume determinations and time of fill calculations only. It should **NOT** be used as a flood insurance study map.

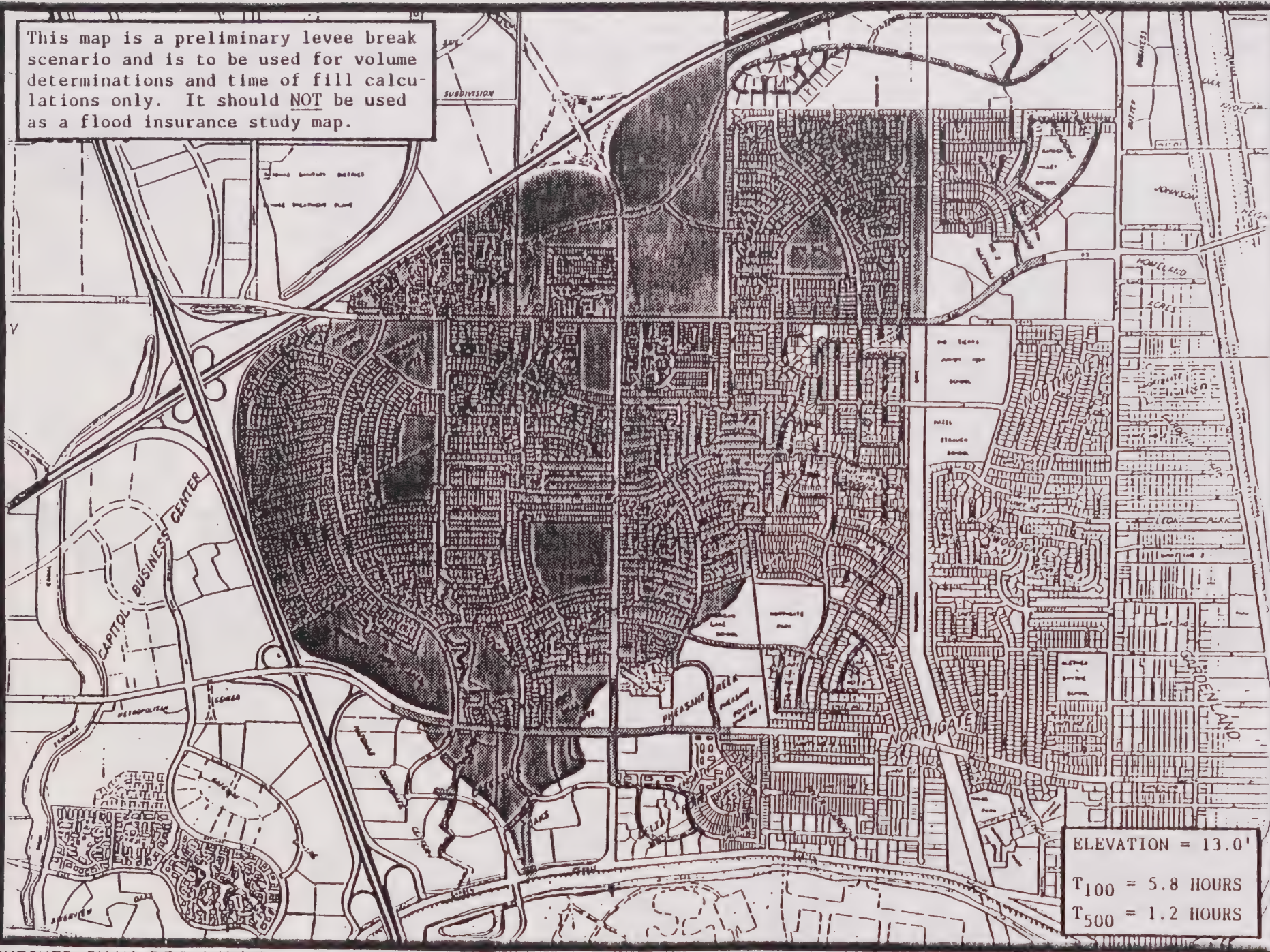


FIGURE 1B-LOCATION 1 CONT

CHECKED BY: M. REID 7/8/88

PREPARED BY: C. BRESSEM

This map is a preliminary levee break scenario and is to be used for volume determinations and time of fill calculations only. It should NOT be used as a flood insurance study map.

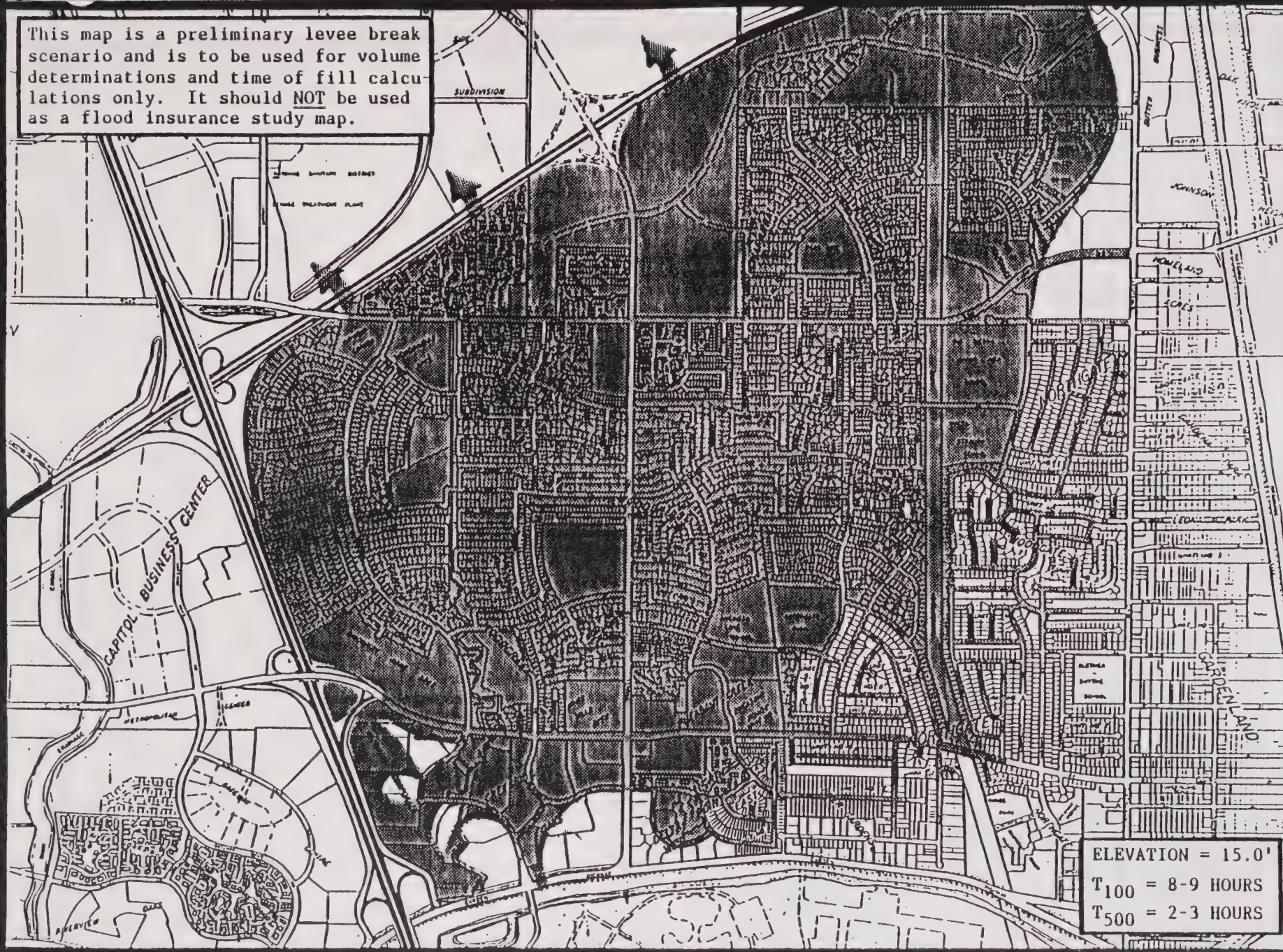


FIGURE 18 - LOCATION 1 CONT.

CHECKED BY: M. REID 7/8/88

PREPARED BY: C. BRESSEM

Location 2 was chosen for potential high velocities, freeboard problems, and the high angle of attack from Arcade Creek. Floodwaters will channel westward through residential streets, such as Indiana Avenue, until reaching high ground at a north-south transmission line easement. Three outflows, San Juan Road, West El Camino Avenue and Edmonton Drive cut through this easement. The total outflow is less than the inflow for a 500' break, making it necessary to perform a split flow calculation. Ponding will occur east of the transmission line easement at the same time that ponding occurs in the lower areas of Southeast Natomas, as far west as the Frates Ranch Subdivision between Azevedo Drive and the freeway I-5 soundwall. This dual ponding effect is best seen on Figure 2, which maps the time v's. elevation.

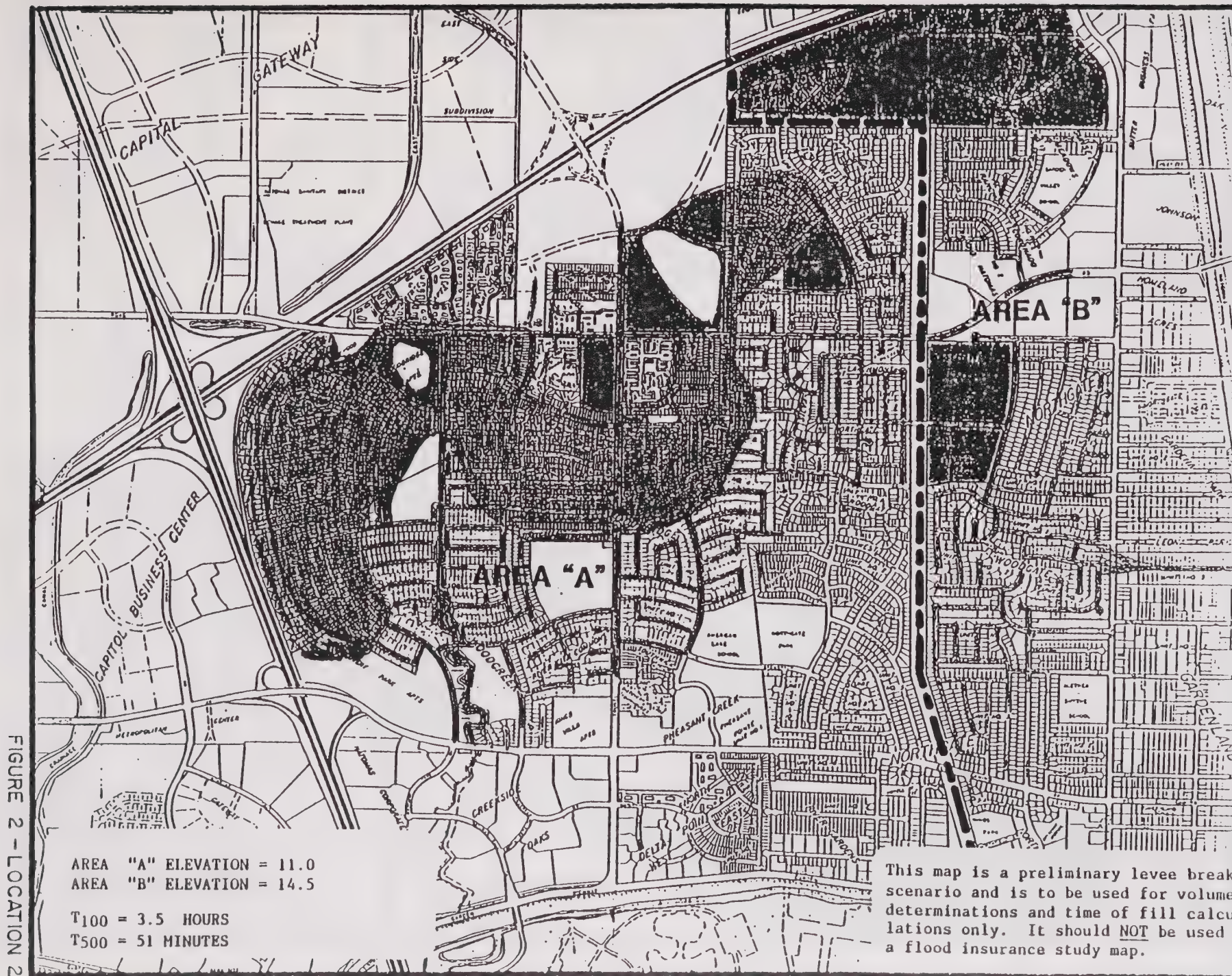
The following table gives a brief recap of Figure 2.

TABLE II
Location 2 - 100' and 500' Breakouts

| Levee Break Size | Elapsed Time (Hours) | | |
|---------------------|----------------------|--------------|--------------|
| | 1) El. 11.5' | 2) El. 13.0' | 3) El. 15.0' |
| 100' | 2 | 3 | 11 |
| 500' | 2.5* | 4.2* | 6-7 |

- 1) 20% of the streets are flooded (1.5'-2' deep).
- 2) 30% of the streets are flooded (1.5'-3' deep).
- 3) 40% of the total area is completely flooded as water is level with the freeway, (end of calculations).

* The elapsed time is shown as greater due to draw down and time lost to receive backwater from the American River.



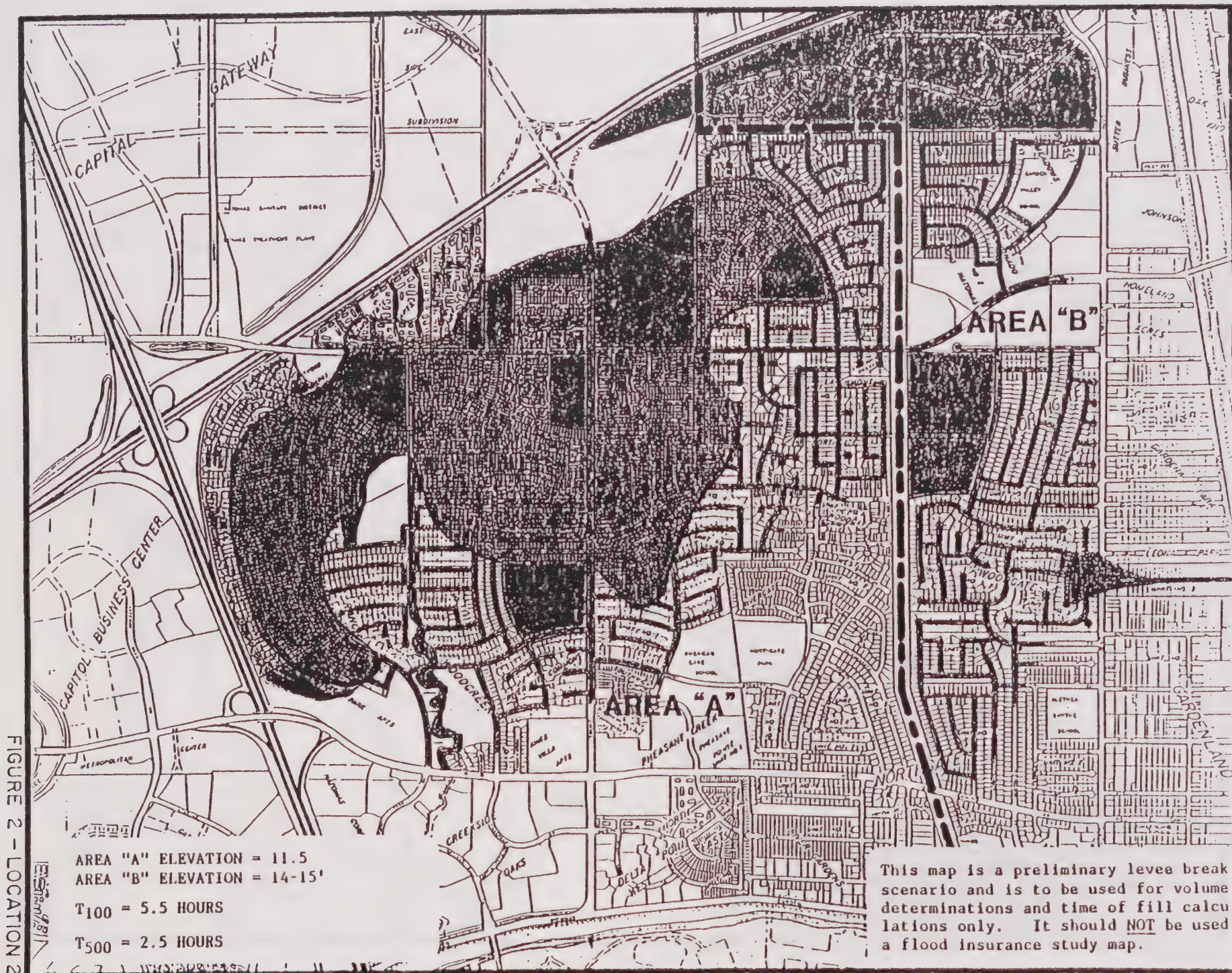


FIGURE 2-LOCATION 2

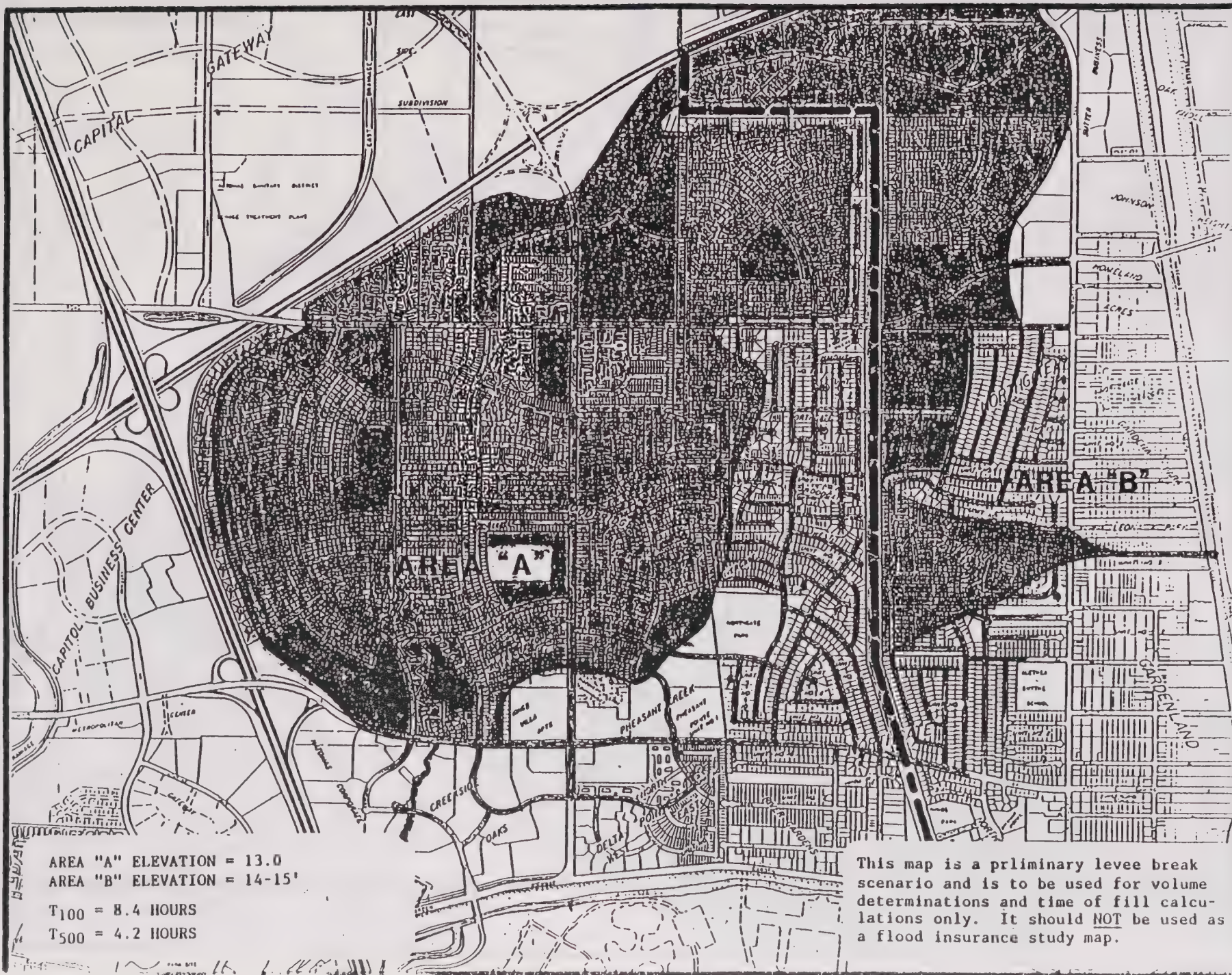
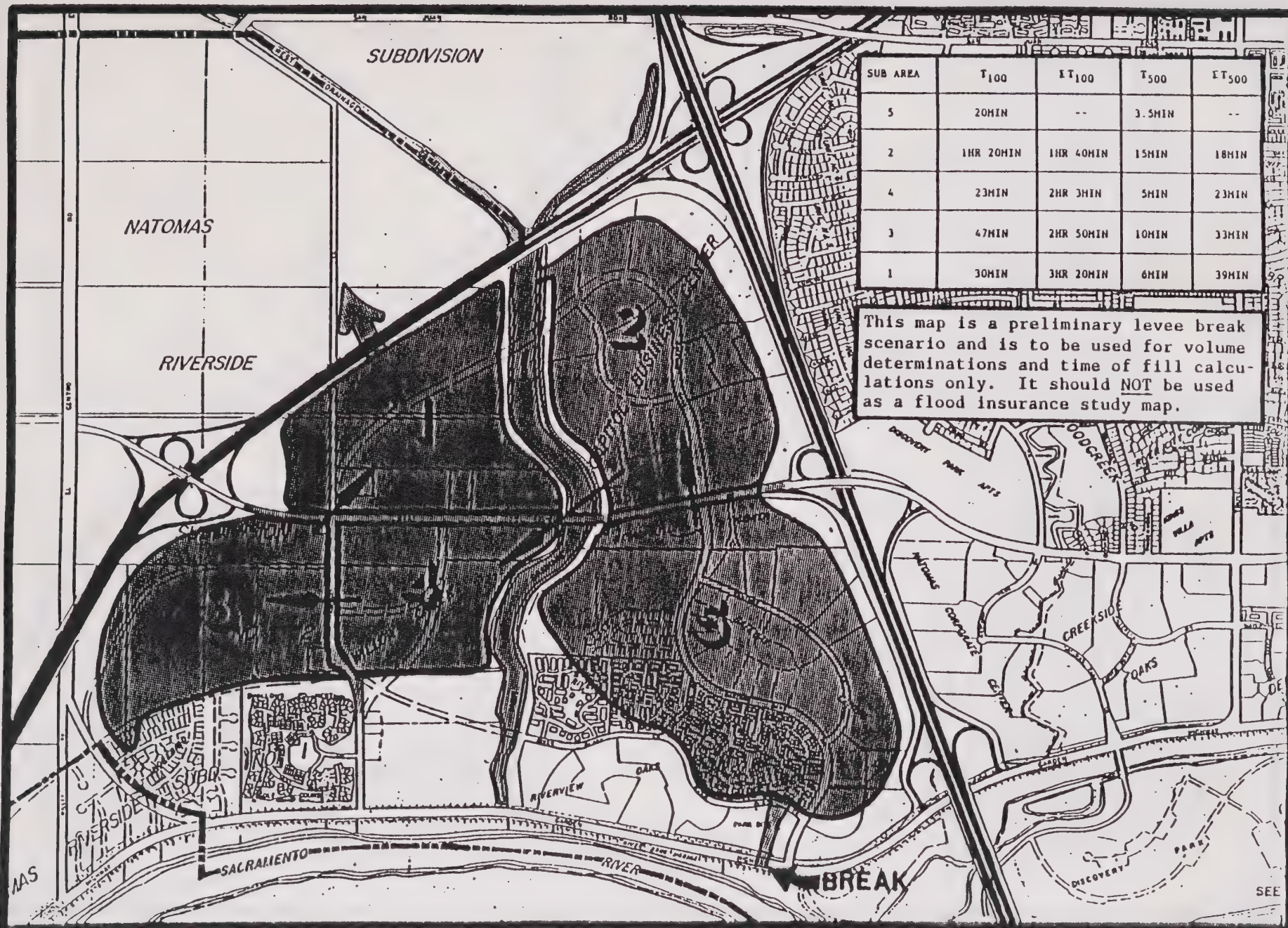


FIGURE 3 - LEVEE BREAK LOCATION 3



CHECKED BY: M. REID 7/8/88

PREPARED BY: C. BRESSEM

West Natomas (Location 3 and Location 4)

Location 3 was chosen to represent any break between the Main Drain eastward to Freeway I-5. The West Natomas basin was split into five separate sub-basins due to the natural topography and the man made weirs, (see Figure 3). Flow will go from sub-basin 5 to 2 to 4 to 3 to 1, then north across I-80 to what is presently the agricultural lands of North Natomas. This flow path is very tentative since the flow path assumes all earthen weirs and barriers are stable. The study also assumes the Main Drainage Canal as being full and unable to store any further runoff. Also, all sub-basins fill to an elevation of approximately 15 ft., at varying depths, before crossing a weir into the next sub-basin. The final outflow over Freeway I-80 is also at approximately 15 ft. crown elevation. It is therefore possible that due to unstable soils, the flow could skip the filling of intermediate basins and take a more direct (and quicker) route to the exit point, rather than flooding the entire basin. The scenario for Location 3 demonstrates the path to fill the entire basin in the shortest amount of time.

The following table illustrates the time sequence for a break in location 3.

TABLE III

| Sub Basin | Elapsed Time (Hours) | |
|-----------|----------------------|------------|
| | 100' Break | 500' Break |
| 5 | 0.3 | 0.06 |
| 2 | 1.6 | 0.3 |
| 4 | 2.1 | 0.4 |
| 3 | 2.9 | 0.6 |
| 1 | 3.3 | 0.7 |

Location 4 was chosen to represent a break between I-80 and the main drain. This breakout will fill sub-basin 3 and 4 to a depth of 2-3 feet before it continues north to sub-basin 1. This break was assumed to take the more direct route to the outlet over I-80, due to momentum. Times used for this model were seen as useful for a "worst case" speed of the floodwaters.

See Figure 4 for a map of time v's flow path at 15 ft. elevation.

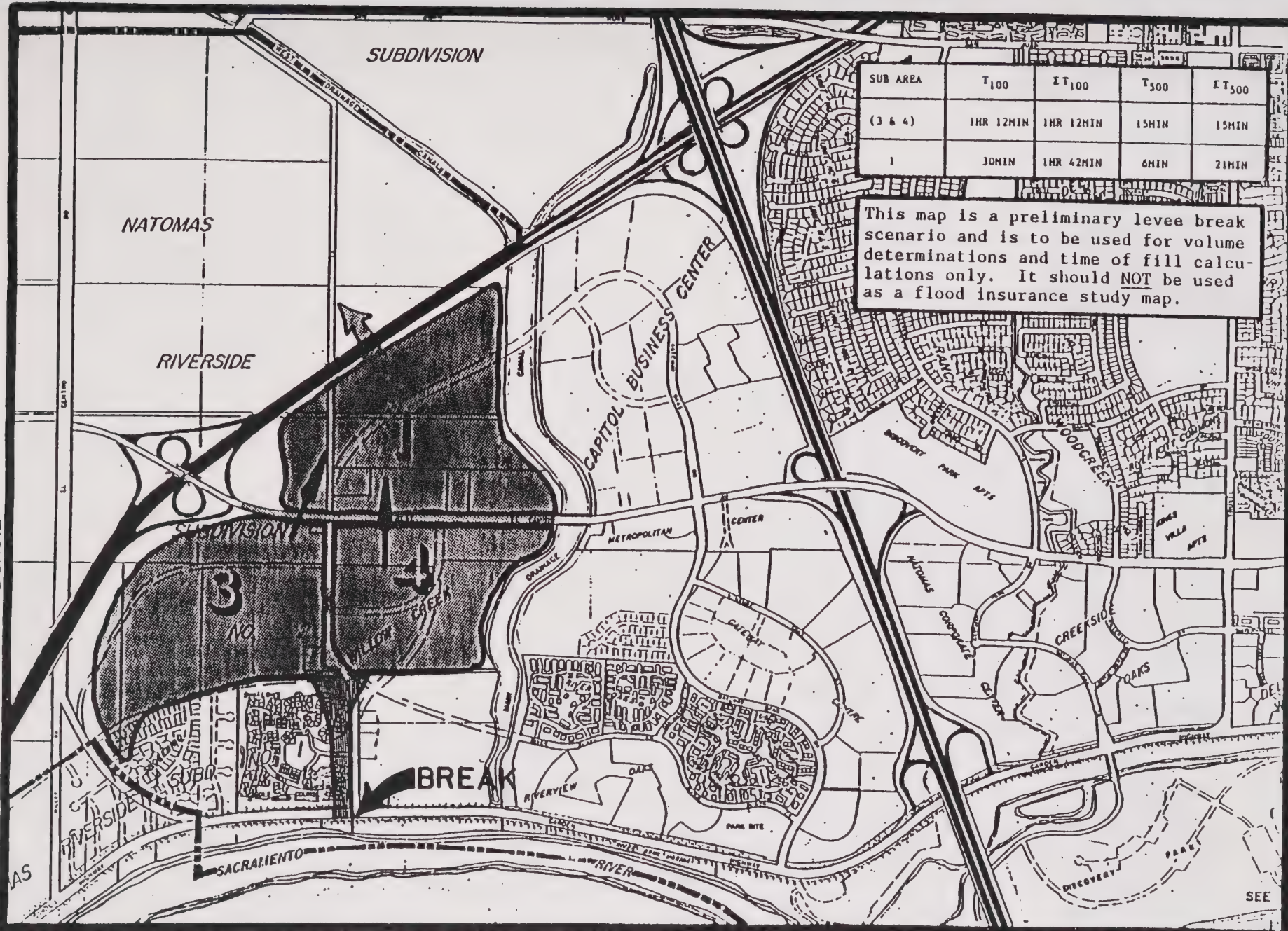
The time sequence is as follows:

TABLE IV
Elapsed Time (Hours)

| Sub basin | 100' Break | 500' Break |
|-----------|------------|------------|
| 3&4 | .9 | .2 |
| 1 | 1.6 | .5 |

NOTE: See Appendix 1 for calculations.

FIGURE 4-LEVEE BREAK LOCATION 4



CHECKED BY: M. REID 7/8/88

PREPARED BY: C. BRESSEM

CONCLUSION

Time is the critical factor with levee breaks of this magnitude. Based upon the assumptions made within this study, South East Natomas would be 40% flooded to a depth of 2.6 feet, within 6 - 7 hours of the levee break. Likewise 70% of the West Natomas basin would be flooded to a depth of 2 - 4 feet in less than 1 hour, with a 500 foot break. Since 1 to 7 hours warning might not be enough time to safely evacuate the area, the evacuation plan should be initiated when the flood waters have encroached half way into the minimum design freeboard requirement. It should be pointed out that many assumptions have been made in this analysis and with additional information the conclusions could change.

APPENDIX I

***EQUATION TO DETERMINE PERCENT RISK ASSOCIATED WITH
FLOOD PROTECTION LEVELS***

The example of flooding can be extended to show some interesting features about probabilities and risks associated with hydrologic phenomena. $P(F) = .10$ implies a 10 percent chance each year for the flood level to be reached or exceeded. In the long run, the level would be reached on the average once in 10 years. Thus the average return period T in years is defined as

$$T = \frac{1}{P(\bar{F})} = \frac{1}{1 - P(F)}$$

and the following general probability relationships hold:

1. The probability that F will occur in any year:

$$P(F) = \frac{1}{T}$$

2. The probability that F will not occur in any year:

$$P(\bar{F}) = 1 - P(F) = 1 - \frac{1}{T}$$

3. The probability that F will not occur for n successive years:

$$P_1(\bar{F}) \times P_2(\bar{F}) \dots P_n(\bar{F}) = P(\bar{F})^n = \left(1 - \frac{1}{T}\right)^n$$

4. The probability, called *risk*, R , that F will occur at least once in n successive years:

$$R = 1 - \left(1 - \frac{1}{T}\right)^n = 1 - (P\bar{F})^n$$

APPENDIX J
FLOOD PROTECTION TIME LINE

Flood Protection: Time Line

WORK DESCRIPTION

Stabilization

Natomas

Greenhaven/Pocket

Reallocation of Folsom

Additional Upstream Storage

Raise Levees—Natomas

TIME LINE (Fiscal Years)

90 91 92 93 94 95 96 97 98 99 2000

LEVEL OF PROTECTION

Sacramento Urban
(American River Only)

63 yr. FEMA 100 yr. 200 yr.

Natomas

40 yr. 70 yr. FEMA 100 yr. 200 yr.

Unstable Levees

Greenhaven/Pocket
(Sacramento River and
American River)

63 yr. FEMA 100 yr. 200 yr.

Unstable levees

APPENDIX K

GLOSSARY

GLOSSARY

1. A-99 Zone - Area of special flood hazard where enough progress has been made on a protective system, such as a dike, dam, or levee, to consider it complete for insurance rating purposes.
2. Acre-Ft (ac-ft) - The amount of water necessary to cover an acre one foot deep.
3. Boils - The discharge of seepage carrying earthen material on the land side of the levee.
4. CFS - Cubic Feet Per Second
5. DWR - Department of Water Resources
6. EIS - Environmental Impact Statement
7. Erosion Failure - The washing away of the levee section due to high velocity flows or waves.
8. Fannie Mae - Federal National Mortgage Association
9. FHA - Federal Housing Agency
10. FHBM - Flood Hazard Boundary Map
11. FEMA - Federal Emergency Management Agency
12. FIRM - Federal Insurance Rate Map
13. Freeboard - The distance between the water level the levees were designed for and the tops of the levees.
14. Head - Difference in water levels between the stream and the land side.
15. Levee - An embankment built to prevent a body of water (i.e., a river) from flowing into the surrounding terrain.
16. McKinney Homeless Assistance Act of 1988 (H.R. 5247) - This act contains the language for the special legislation which restricted FEMA from placing elevations on the FIRM maps.
17. NEMDC - Natomas East Main Drainage Canal
18. NEPA - National Environmental Management Agency



19. NFIP - National Flood Insurance Program
20. OES - Office of Emergency Services
21. One-Hundred (100) Year Event - A flood of such a magnitude that it would have a 1 percent chance of occurring in a given year.
22. One-Hundred (100) Year Plain - An area that would be flooded if a waterway overflowed its banks given a 100-year flood event.
23. SACOG - Sacramento Area Council of Governments.
24. Seepage, or Piping Failure - The result of water moving through the levee at a rate high enough so that it will cause erosion of the levee material internally within the levee section.
25. SF - Square feet (sq. ft.)
26. Sheet Flows - Area of shallow flooding, designated AO, AH, or VO zone on a community's FIRM, with a one percent or greater annual chance of flooding to an average depth of one to three feet where a clearly defined channel does not exist, where a path of flooding is unpredictable and where velocity flow may be evident.
27. Structural Instability Failure (Sloughing) - Inadequate strength to maintain levee section.
28. USBR - US Bureau of Reclamation
29. U.S.COE - United States Army Corps of Engineers
30. Warning Time - The time between when the affected population first receives notice of a possible inundation and the actual inundation.
31. Weir - A dam built to direct or back up the flow of water.
32. Overtopping Failure - The surface elevation of the water spills over the top of the levee to the surrounding terrain.

